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The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

VOLUME XXXIV NO. 2

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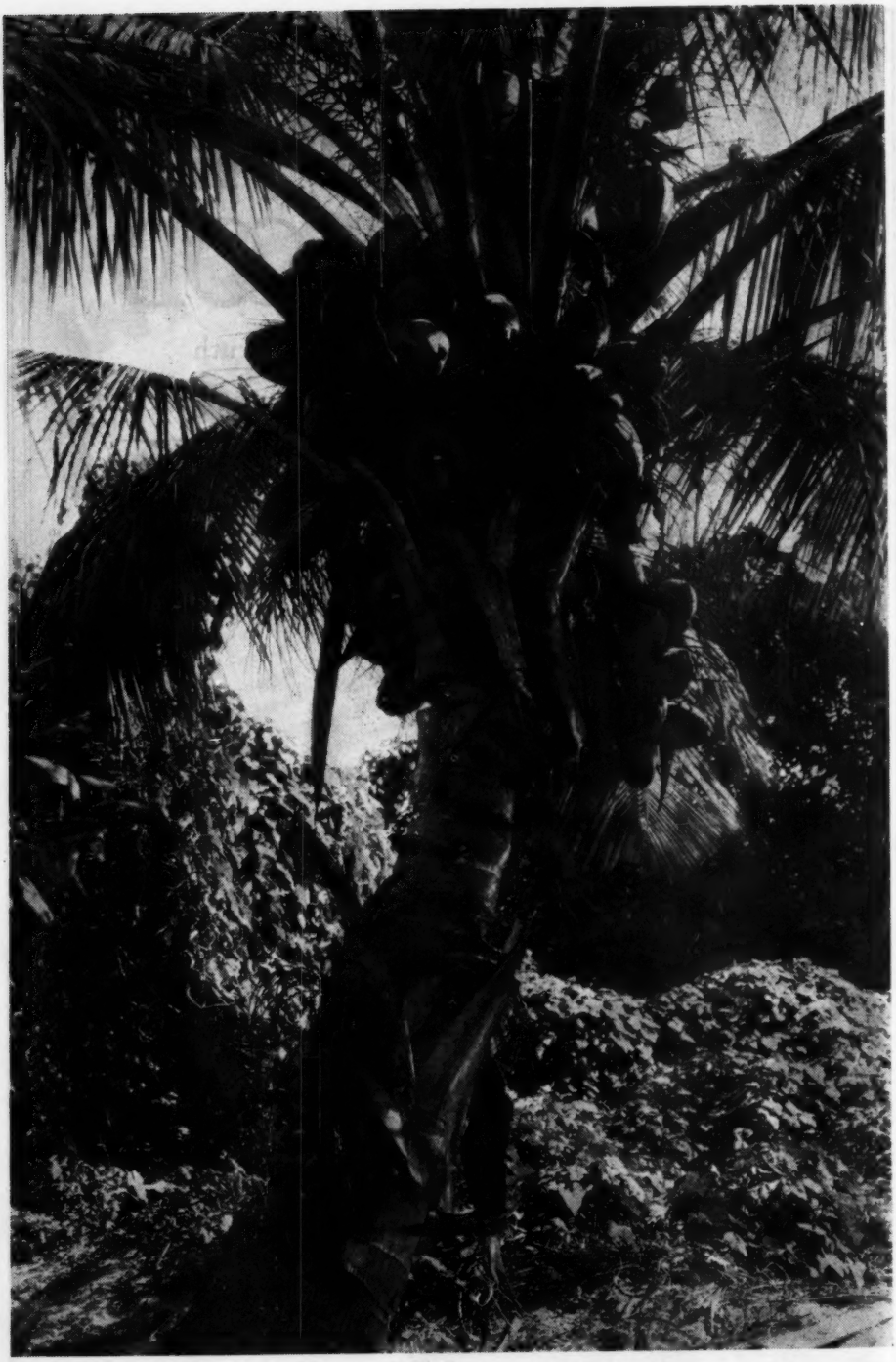

Ready to Drop?

Better Crops with PLANT FOOD

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VOL. XXXIV WASHINGTON, D. C., FEBRUARY 1950 No. 2

Europe's Dilemma . . .

Splintered Acres

Jeff McDermid

"LET'S help 'em get the women and girls and the cows and oxen out of the farm-power business, and then consolidate some of those little scattered plots of land into wide fields for tractors, manure spreaders, gang plows, and combines." That neighborly cry of sympathy to French and German brethren of the soil was voiced repeatedly by American farmers touring abroad last summer. It will be the war cry again in 1950 as legions of land operators from here sail or fly to the older farm sections of the world. This plea has been the invariable remedy for farm recovery in foreign lands, where yield per acre is often higher than it is here, although purchased at an enormous waste of labor and a consequent low output per worker on farms.

While declaring stoutly for mechanized agriculture, the visitors will usually admit that the soil on many of these small strips is fairly productive, sometimes highly so. They will often remark that conservation of crop residues and animal manures and wide use of commercial fertilizers have advanced faster over there than they have in many parts of our own country.

In general, then, we have to recognize that our farming system is better on top of the land than theirs, while maybe their method is a trifle advantageous underneath the surface, compared with ours. That is, what we do to the land with motive power is superior, while their intense zest for

conserving tilth and fertility shames our extensive, hasty, prodigal, and neglectful soil mismanagement.

Some facts basic to consideration of possible adjustment of splintered acres into workable fields and the extent of the problem involved were secured last summer by the writer from sources in France and Germany. Our authority in France is Denis R. Borgman, economist with the Ministry of Agriculture, and in Germany our points come from Paul Taggart and his associates in agricultural extension for the U. S. Military Government's food division.

The small average size of French farms is the main drawback to better layouts. More than one million of the estimated two and one-half million farm units in France are under 25 acres. The second cause that harms layout is the clustering of farmsteads around compact villages, most common in northeastern France, brought about by economic and social influences, scarcity of land in relation to people, and rigid community rules as to rotations and grazing. The final cause lies in the ending of primogeniture late in the eighteenth century, making more heirs to a given tract and hence more splitting.

IT is stated that the average-size land parcel in France is about 0.35 hectares or just under one acre. This is shown on the existing cadastral maps, but there may be cadastral boundaries even where there are no changes of owners, so a good estimate is that the actual average size of the pieces belonging to each owner is at least two or two and one-half acres. Where one whole commune is operated by one farmer or where cash tenants farm on land that belongs to several absent owners, boundaries can be adjusted and layouts improved for machine use.

Then there are the legal and organization sides to it, both worth passing notice. The French Planning Board has the so-called Monnet plan to suggest as a goal. The plan calls for rectangular fields, with their sides not less than 325 feet wide by 975 feet long, with a minimum of about eight acres, and to be located not more than two miles from the farmstead. This was a target to shoot at, but signs of progress being made to reach it are not numerous.

BACK in 1918 after some bitter strife, the Chauveau Act was passed. This provided that in a given area it would be compulsory to regroup land tracts along certain lines if requests for this move were filed by more than two-thirds of the owners of over half the area, or more than one-half the owners of over two-thirds of the area. This resembles the local option deal so long in vogue here for livestock disease control, such as the area test.

The law provided that safeguards against unfair separation and distribution of the land would be granted. Hence every owner ended up with the same acreage he put into the pool, and with just as good soil as a rule. Results were pretty slow, however, except in the badly eroded and broken battlefield areas of France, where less opposition and delay were met in completing the regrouping.

From 1919 through 1941, or through all the era of peace between the two world wars, only 615 communes with about 700,000 acres were regrouped. It is not hard to tell why faster headway was not made. There was no aggressive educational and extension work done to show the advantages of such shifts and adjustments in land patterns. The Ministry of Agriculture was ready with engineers to service the farm villages on request, and the government promised to stand part of the expense of surveying the tracts. Inertia and family tradition and devotion to certain specific plots of soil slowed down the movement and almost halted it for awhile.

Yet it isn't dead. The idea takes on new life since the Ministry of Agriculture is in league with ECA and other wise and hustling foreigners, includ-

ing corps of U. S. extension teachers and mechanical experts. France now has more available farm machines and a growing number of tractors, with the usual crew of active fieldmen who all take part more or less in propaganda for real progress.

Besides the extra voices raised in behalf of larger tracts, a newly amended federal law has been in force for a year or two. It simplifies the procedure

which was required under the old law and cuts out the "one-half and two-thirds" jinx. The new law says that a communal board living in any rural village may hire a surveyor to draft up a regrouping plan. Then when the plan has been finished and the board has conned it all over very carefully, a public hearing is announced. Here the farmers who live in the commune, and work the scattered plots around about, are free to speak up. Thereupon the board decides what to do. Usually they adopt the survey plan and then it becomes compulsory. Each owner must wind up with all of his land in one piece—a much more direct and drastic provision than the other law provided.

Probably this new and stronger law actually reflects the new and different attitude toward consolidations. It has been brought about largely by so many more tractors—France having nearly 125,000 of them last year. Inflated costs of fuel and oil for the operation of power farm machinery remain a terrific drawback, yet 500,000 acres were involved in regrouping plans in one year alone, or about as much land as received this adjustment during the whole 1919-40 peacetime period.

The French treasury pays 80 per cent of the survey and office overhead expenses. Appropriations fail to keep up with actual rising costs. On the average these costs have risen from about $2.50 per acre in 1947 to $3.75 per acre late in 1948.

SOME areas outside of the French northeastern zone have diversified plantings of vines and fruit trees lying along the hillsides, especially in the famous champagne region near Rheims and Epernay. Other zones are at such high altitudes that field boundaries are fixed by topography and are not easy to relocate in justice to all concerned. Under both these conditions it has been more difficult to settle these adjustments on the same pattern that would fit the more level and general farming sections.

One force that has taken a big part in the gradual change in terrain and which has knitted small pieces into larger tracts is the rapid emergence of the French machinery cooperatives. None of them existed before the war, except for doing threshing jobs. The latest data on them estimate their number at 8,500. They are officially called Cooperatives d'Utilization de Materiel Agricole. In our usual terms, their alphabetical title is CUMA. Our Economic Cooperation Administration workers have dealt with them and the U. S. makers of agricultural implements know them very well, as do the fast expanding domestic farm machinery plant managers and their active field salesmen. Indeed this commercial and government encouragement of their work is responsible for much of their growth.

By recent guess made to me at Paris, the co-ops are said to own about one-fourth of all the farm tractors in France. Many of the co-ops have only one tractor and a few implements, but

(*Turn to page 49*)

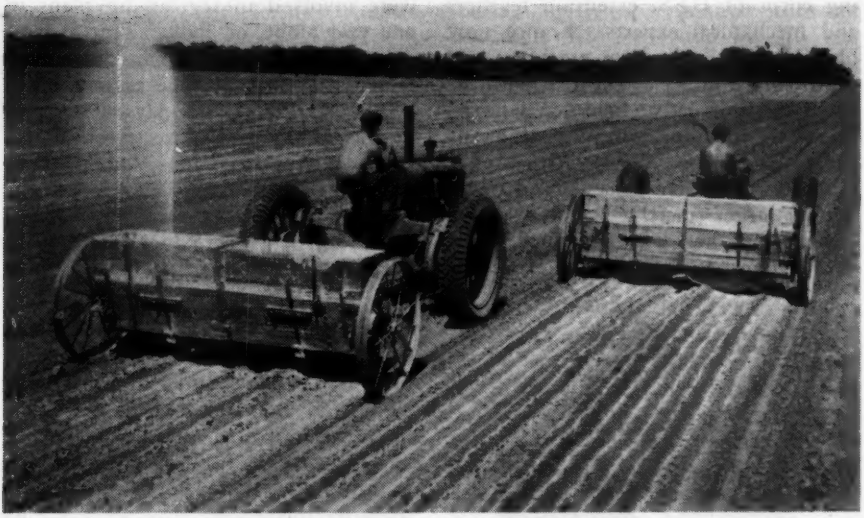

Fig. 1. Broadcasting fertilizer on asparagus in early spring.

Fertilizer Placement for Vegetable Crops

By Alvan C. Thompson

Production Manager, King Farms Co., Morrisville, Pennsylvania

FERTILIZER is usually the largest single cost item in vegetable crop production. It often amounts to more than the combined cost of lime, seed, and spray materials.

Large amounts of fertilizer are generally necessary for heavy yields and high quality vegetables. However, if improperly used, fertilizer may cause injury to sprouting seeds or plant roots. Another angle to consider is the loss of plant food in fertilizer that is applied too far in advance of crop needs. This loss occurs by leaching of soluble materials or fixation into relatively unavailable forms.

Perhaps the methods of fertilizer placement and reasons for certain practices can be brought out best by talking about how it is done at the King Farms Co. Many people know our location at Morrisville, Pa., directly across the Delaware River from Trenton, N. J. The total area consists of about 7,000 acres, with about 3,000 used for vegetable production. The present list of crops grown includes asparagus, rhubarb, spinach, beans, broccoli, cabbage, cucumbers, carrots, beets, parsnips, turnips, tomatoes, parsley, and onion sets. In past years other crops have been grown, such as lima beans, sweet corn, cantaloupes, lettuce, peppers and eggplant. Having a list not too large

simplifies the growing and handling of the crops.

The soil we farm is of glacial origin. In places gravel outcrops at the surface are so heavy that some fields are unfit for farming. But over much of the area there is four or five feet of fine moulding sand under the topsoil. The topsoil varies in depth from about 6″ to 10″. The soil composition is variable in different fields, but most all of it is of an open porous nature having good drainage. The physical makeup runs high in sand content, some having gravel, with a low percentage of clay and silt particles, making it possible to get on it quickly after rains in the crop-growing season. We have found that this soil is responsive to good treatment, but also unproductive under bad treatment. It has a low retentive capacity, making it subject to quick change. Ordinarily, the pH will drop back about .5 of a point due to leaching, crop removal, and natural soil processes during each year. The soil survey by the U. S. Department of Agriculture classifies our soil as Sassafras loam, Tioga silt loam, Tioga loamy fine sand, Chonango gravelly loamy sand, and two or three others.

When the land was first taken over about 20 years ago, much of it was in a run-down condition. This made it necessary to apply large amounts of lime, commercial fertilizer, some manure, and lots of cover crops to build up the organic matter. Usually whenever cover crops or crop remains were turned under, cyanamid was added to hasten decomposition and improve fertility.

Plant-food Requirement of Vegetable Crops

Most vegetable crops in the early stages of growth require only a small part of the total plant food necessary to grow the crop. In Bulletin 1 published in January 1939 by the Campbell Soup Company, Hester and Shelton show that the tomato crop uses only 3 per cent of the total plant food the first month, 27 per cent the second month, and 70 per cent after the end of two months. In a book just published by the American Potash Institute a table shows that a crop of garden peas uses 5 per cent of the nitrogen, phosphorus, and potash the first 30 days, 55 per cent the next 30 days, and 40 per cent in the next 14 days. In the case

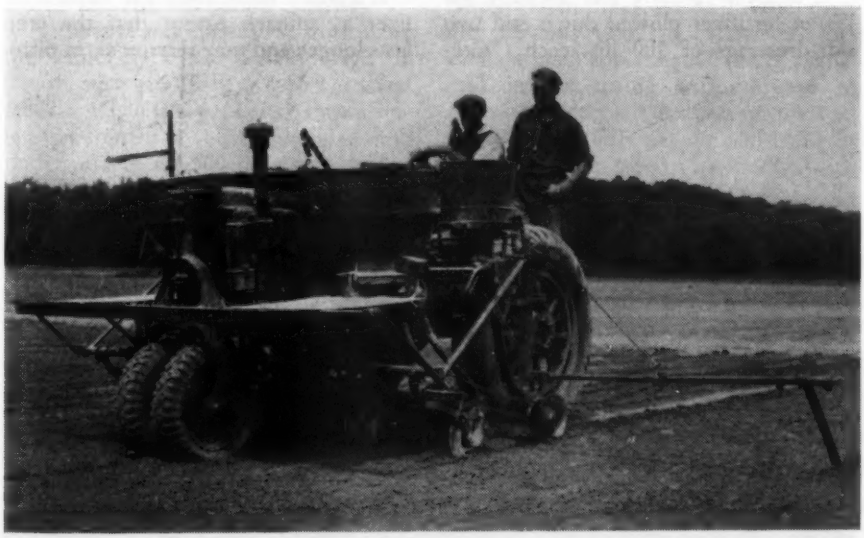

Fig. 2. Planting four rows of beans at a time and applying a band of fertilizer at each side of the row.

of carrots they say the crop uses only 4 per cent of the potash in the first 70 days, 27 per cent in the next 30 days, and 69 per cent in the next 30 days.

Twenty years ago most vegetable growers were still farming with horses. We found it necessary to adapt horse-drawn equipment to tractors, since multiple row seeders and fertilizer side-dressing equipment were not on the market at that time. One of the machines we assembled was a four-row bean planter, which we still use today. It places a band of fertilizer at each side of the row. Previous to having this machine, we were using 1,500 lbs. of fertilizer broadcast for a crop of beans. This machine cut the amount down to 700 lbs. placed in bands.

Another thing which saved a lot of fertilizer for us was the making of side-dressing fertilizer equipment to hang on tractors. Instead of applying all the fertilizer for crops like cabbage and tomatoes before or at the time of planting, we were able to put a smaller amount on at the start and later side-dress during the growing period.

Methods Used to Fertilize Several Other Vegetable Crops

1. *Broccoli* usually has about 1,500 lbs. of fertilizer plowed down and two side-dressings of 500 lbs. each. *Cabbage* usually has 1,000 to 1,500 lbs. plowed down and one side-dressing of 500 lbs. Plant starter is not used because there is very little response on our soil due to the large accumulation of phosphorus.

2. *Cucumbers* and cantaloupes are rather sensitive to fertilizer, and usually have 1,000 lbs. or less plowed in wide bands 3″ to 4″ from the row. For additional fertilizer, it may be plowed down, or extra nitrogen applied through irrigation water.

3. *Tomatoes.* 500 to 750 lbs. of 5-10-10 fertilizer were plowed down, 500 lbs. 5-10-10 side-dressed 30 days after set, and 500 lbs. 7-7-7 at last cultivation. Plant starter was used at setting.

4. *Spinach.* We have been using from 1,200 to 2,000 lbs. of 5-10-10, 5-10-5, and 7-7-7 based on fertility test of the soil. Additional nitrogen is usually obtained by plowing down cyanamid or applying nitrate of soda pellets as a topdressing or in the irrigation water. Under our conditions we have been applying all of the mixed fertilizer broadcast to the surface and discing in before planting (except for fertilizer residue from previous crops).

5. *Parsley* takes about the same fertilizer as spinach except that the crop lasts longer and may require extra nitro-

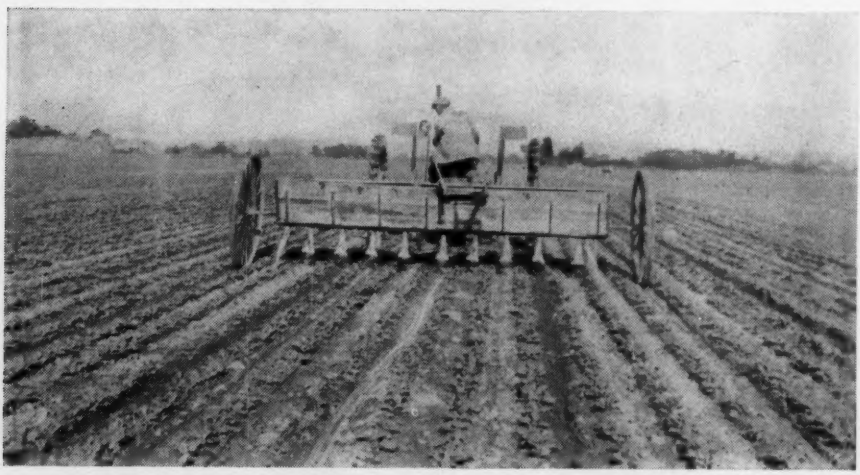

Fig. 3. Applying nitrate of soda topdressing to spinach.

Fig. 4. Applying 300 pounds granular cyanamid per acre for plowing under.

gen. One-half of the fertilizer should be plowed under.

6. *Beets.* Usually about 1,200 to 1,500 lbs. of 5-10-10, 7-7-7, or 4-12-8 are used, depending upon soil test and time of year. Usually a mixture carrying higher nitrogen is used for early spring. All is commonly broadcast and harrowed into the soil before planting.

7. *Carrots* and *Parsnips* require about the same fertilizer, usually high in potash, such as 5-10-10 or 4-12-8 at about 1,800 to 2,000 lbs. per acre. Two-thirds to three-fourths of this should be plowed under and about 500 lbs. broadcast on the surface and harrowed in before planting.

8. *Turnips* usually require very little fertilizer and will often make a good crop on the residue left in the ground from a previous crop. There is some danger of over-fertilizing and growing big tops. If soil test is not up, about 500 lbs. of 5-10-10 broadcast and harrowed in the surface should grow a good crop.

9. *Asparagus.* Effective results from fertilizer are dependent to some extent on the liberal use of lime on asparagus. Lime not only liberates plant food in the soil, but makes fertilizer act more effectively and supplies calcium and magnesium. A common practice among growers is to apply about one ton of fertilizer per acre broadcast, splitting the application so that half goes on in early spring and half at the end of the cutting season at the end of June. However, the asparagus crop is produced largely from food stored in the roots the previous year, so in recent years we have been applying 300 lbs. of cyanamid in the spring and one ton of mixed fertilizer at the end of the cutting season. This can be a 5-10-10 or 7-7-7. In the asparagus seedbed we have used a 4-16-10, and then usually a 4-12-8 for the first year or two after set out. After the bed gets into cutting we like to feed liberally with about a 1-1-1 ratio and use lots of lime. Cyanamid is an excellent source of nitrogen, and if applied to the ridges about 3 or 4 weeks after cutting begins in spring at the rate of 900 lbs. per acre on the area covered, it will control weeds as well as supply 50 to 60 lbs. of nitrogen per acre. When asparagus roots are first set out, 1,000 lbs. per acre of superphosphate applied in two bands about eight inches apart down in the bottom of the trench will last for quite a while with-

out much loss from fixation, and the extra phosphorus will develop strong root systems. We made up the tractor to do this by extending the tubes down into the trench, in our regular two-row side-dresser, and by using dual wheels on the tractor, both front and rear, to straddle the ridges.

10. *Rhubarb.* This is a perennial crop, also, and produces its crop from growth made the previous season. Rhubarb is a rather heavy feeder and requires about one ton of 5-10-5 or 7-7-7. The plants are checked in 4-ft. hills, and the fertilizer is applied in bands in two applications about a month apart at the time of cultivation, the first being made in early spring.

11. *Sweet Corn.* From 500 to 1,000 lbs. of 5-10-10 fertilizer may be applied in bands 2″ to 3″ from the row at the time of planting. Growers often side-dress with 150 to 200 lbs. of ammonium nitrate or sodium nitrate when the corn is knee high.

12. *Potatoes.* The usual application is about one ton of 5-10-10 or 4-12-8 acid goods applied in two bands placed about 2″ each side of the row and 2″ below the seed piece. The application of 150 lbs. ammonium nitrate as a side-dressing at the last cultivation has been known to increase the yield of potatoes 100 bu. per acre. Fertilizing the fall cover crop is another practice used for several years in central New Jersey and has increased yields from 50 to 100 bu. per acre. Usually 800 to 1,000 lbs. 7-7-7 fertilizer or 300 lbs. cyanamid are broadcast and disced in before seeding the cover crop, since the grain and fertilizer cannot be sown together because of the danger of burning. This method of fertilizing the cover crop and plowing it down in spring changes inorganic material over into organic material, giving the potato crop an extra reserve of plant food to draw on and produce a bigger crop.

Applying Fertilizer Through Irrigation Water

Dry fertilizer is of little value, since plant food must be in soluble form before it can be absorbed by the roots. Water from rain or irrigation dissolves the fertilizer salts, which have been carried upward toward the surface during dry periods, and again carries them downward within reach of the plant roots. For this reason thorough water-

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Fig. 5. Applying fertilizer in irrigation water.

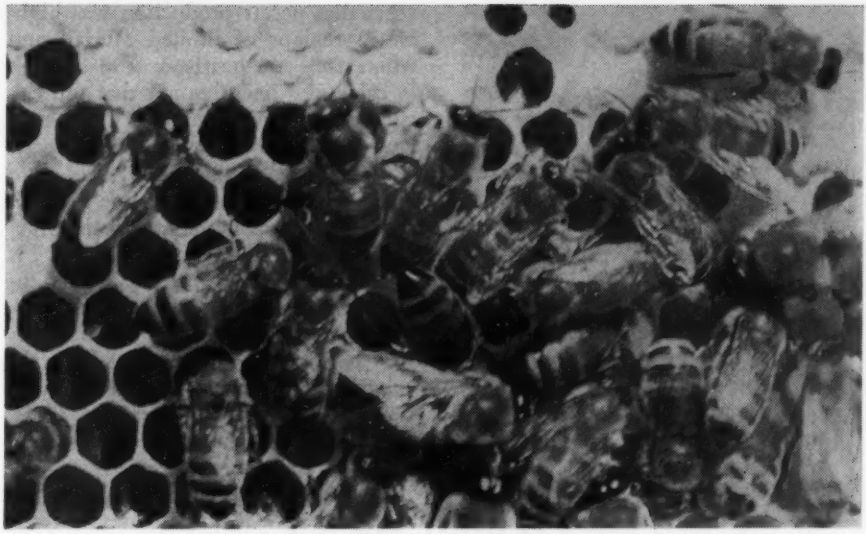

Fig. 1. Bees are efficient pollinators for legumes and carry the nectar home.

Put the Bee on Southern Agriculture

By G. B. Killinger and John D. Haynie

Florida Agricultural Experiment Station and Extension Service, Gainsville, Florida

IT has long been realized that for a successful agriculture in the Southland legumes must be utilized in the farm programs. To be successful in the culture of legumes bees are necessary. This necessity stems from the fact that many legumes require bees or other insects for tripping in flower fertilization or for cross pollination when individual flowers are self sterile.

Growing More Legumes

Experiment Stations, Extension Services, and Federal Agencies have played an important part in increasing legume plantings throughout the South. Most of this increased planting has come about within the last 15 years. AAA and more recently PMA payments have greatly stimulated this phase of the agriculture program.

Dixie crimson clover, ladino clover, Southern white clover, lupines, hairy indigo, several strains of red clovers, lespedeza, trefoils, and various other legumes have greatly increased in acreage during the past few years. New strains of some of these carrying disease resistance and legumes producing hard seed which allows for natural reseeding or volunteering have stimulated farmers into giving them a trial.

Pasture legumes should either be perennial by nature or produce suffi-

Fig. 2. Honeybees are very active on Hubam sweet clover bloom.

cient seed each season under normal grazing practices for a natural reseeding. Until recent years the legumes grown in Florida were limited by their inability to perpetuate themselves. Improved fertilization practices with new strains and varieties of old legumes and new legumes have materially changed the outlook for their culture.

At present most legumes grown on the acid soils of Florida require the soil to be treated with from one to two tons of limestone per acre every four or five years and annual applications of 500 to 800 pounds per acre of an 0-14-10 or 0-10-10 fertilizer. On certain soils minor elements have been needed, particularly copper and in some cases manganese and zinc, to successfully produce the legumes. Borax has given a response at several locations, as evidenced by seed production and leaf appearance on sweet and black medic clovers.

Bees Depend on Pollen

Beekeeping is a profession with some men and they are dependent upon the sale of honey and bees for their livelihood. The honeybee and the bumblebee rely on nectar-producing flowers for their existence. In Florida, perhaps most of the honey production comes from the citrus, tupelo (black gum), and gallberry blossoms. A great many other domesticated and wild flowering plants also contribute to honey production. Apiculturists have noted for some years that nectar production was highest in regions of limited rainfall and where soils are nearly neutral or high in calcium. It is thought that soil calcium supply and content of plants may have a direct bearing on nectar secretion.

Nearly every type of legume flower is worked by bees or other insects either intensively or to a limited extent. If no nectar is present, bees may work the blossom for pollen. Bees are dependent upon pollen as their protein supply for rearing the young brood in the colony. No measure of honey production from sweet clover grown under Florida conditions has been made, although bees are very active on this plant. Many acres of this annual sweet clover are grown in the State; however, most of the acreage is widely distributed along railroad embankments and highways where soils are nearly neutral and well supplied with calcium.

Bees do not work white clover blossoms nearly as vigorously as the sweet clovers. Usually on a clear warm spring day many honeybees and bumble bees can be found in a freely blooming white clover pasture.

Increased Seed Crop

In the fall of 1943 a number of small fertility plots were seeded to a mixture of mildew-resistant strains of red clover. These plots have satisfactorily reseeded for the past six seasons, although usually only a few seed can be found in any one seed head. Some years ago it was thought that only bumblebees could pollinate this particular plant. In more recent years it has been found that the honeybee can do the job very well.

In the spring of 1949 a colony of bees was transported to this red clover area to determine their effect on seed production. Two cages six feet square covered with cheesecloth were placed on the area and all blossoms showing were plucked off. One of the cages was opened so that bees from the colony could either enter the cage or the outside but other bees and insects could

TABLE I.—EFFECT OF HONEYBEES AND INSECTS ON RED CLOVER (TRIFOLIUM PRATENSE) SEED PRODUCTION

Treatment of 36-sq.-ft. plots	Av. from 20 seed heads		Yield calculated from 36-sq.-ft. of harvested plot
	No. of pods per seed head	% of pods with seed	Pounds of seed per acre
Caged—no bees	91.6	0	11.2
Caged—with bees	74.6	53.0	57.9
Not caged—all bees and insects	83.6	81.1	83.5

not enter the cage. The second cage was completely covered and no bees or other insects were allowed to enter.

In May when the clover seed were mature, random samples of 20 seed heads were taken from each caged area and a like number from a six-square-foot plot area which had not been caged. The entire plot (36 square feet) for each of the three treatments was then harvested. Legumes or pods per seed head, percentage of seed per pod, and pounds of seed per acre are given in Table I.

No seed were found in any of the seed pods from the 20 seed heads picked at random from the caged area which excluded bees, yet some seed were set, as noted in the yield column. The yield of 11.2 pounds of seed per acre from the 36-square-foot caged area was small but indicated some fertilization which may be attributed to natural causes or other very small insects which may have penetrated the cheesecloth or hatched out under the cover.

The caged area which allowed bees to come and go but excluded bumblebees, wild bees, and other insects produced clover seed in 53 per cent of the pods and yielded 57.9 pounds of seed per acre.

The area not caged and to which all bees and insects had access had seed in 81.1 per cent of the pods and yielded

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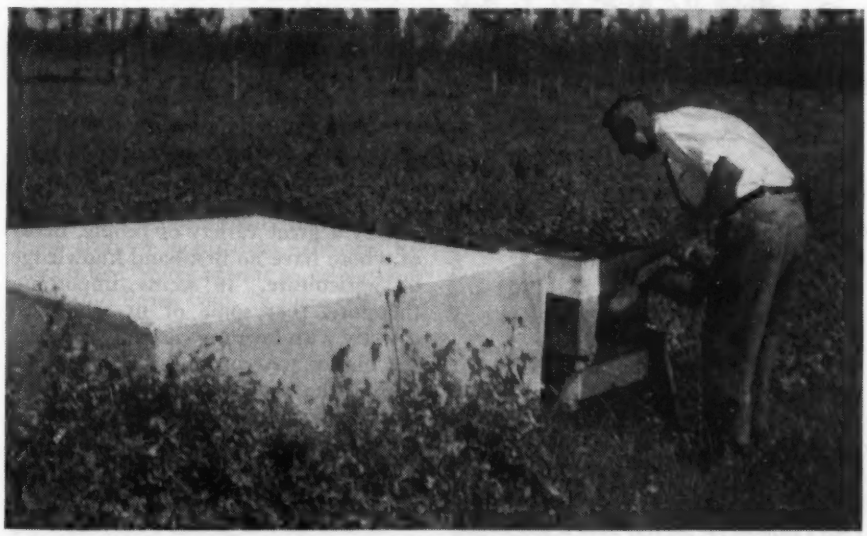

Fig. 3. Honeybees caged on freely blooming red clover increase seed crop.

Food for Thought About Food[1]

By Firman E. Bear[2]

ALICE, in Wonderland, was running hand-in-hand with the Queen, and just as fast as she could. But she was surprised to find that she wasn't getting anywhere. The Queen said, "What did you expect?" "Well," panted Alice, "in our country you would generally get to somewhere else." "That's a slow sort of country," said the Queen. "Now *here,* you see, it takes all the running you can do to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that."

We older agronomists have to run as fast as we can just to keep pace with the rapid developments that are taking place in food and fiber production. We depend on the younger men "to get somewhere else." They are not handicapped by having learned so many things that are no longer so.

All of us see the need for abundant supplies of food and fiber—enough to meet the requirements of all our people all the time. We recognize the importance of having substantial surpluses for export. We think it essential to have reasonably large quantities in storage to carry us safely through in time of drought. Finally, we are impressed with the necessity of having dependable reserves of productive capacity that can be called into play in the event of war or other world catastrophe.

". . . The most accurate population estimates for the United States appear to be those of Raymond Pearl, who, 25 years ago, predicted a population of 149 million people for 1950. Pearl's estimate for the year 2000 is 186 million. To be on the safe side . . . it is believed that plans should be developed for 200 million."

Planning for 200 Million People

Recently, the 150-year-old Malthusian principle has been revived. Malthus asserted that population tends to increase up to the limit set by the food supply. His concepts fell into disrepute, however, with the rapid agricultural development of the New World during the nineteenth century. But much is now again being said about this subject by a great variety of people, many of whom have no first-hand knowledge of agriculture. It seems important, therefore, that some of us who deal directly with farming carefully consider the matter. Accordingly, I propose to outline the potentialities for food and fiber production in the United States of America in relation to our future needs.

[1] Presidential address, 1949 annual dinner, American Society of Agronomy, Milwaukee, Wisconsin, October 26, 1949.

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Population growth provides a good starting point. When the first settlers arrived some 350 years ago, the 1,905 million acres that now constitute the United States of America was an Indian Paradise, with about 800,000 people in it. During the first 200 years after the white man arrived, the population increased only to about 4 million people. But by 1850 it had grown to 23 million, by 1900 it had reached 76 million, and by 1950 the total number of people in the United States is expected to be 150 million.

This vast new country had tremendous natural resources. Its population grew rapidly because the people prospered. A large percentage of them lived out in the open country where children had economic value. In 1820, over 80% of our people were farmers. Now, 130 years later, over 80% of them live in cities. In the city, children tend to be economic liabilities, knowledge of contraceptives is sought and applied, the capacity to reproduce is lowered, and the rate of increase declines.

The tendency toward a declining birth-rate is being compensated for temporarily by a marked increase in longevity. This is credited to improvements in sanitation, growth in medical knowledge and facilities, and development of new drugs. By the year 2000, it is believed that some 13% of our population will have passed the 65-year mark.

The curve of population growth in any new country is sigmoid. It rises slowly at first, then more rapidly, later it flattens out, and finally it falls. The most accurate population estimates for the United States appear to be those of Raymond Pearl, who, 25 years ago, predicted a population of 149 million people for 1950. Pearl's estimate for the year 2000 is 186 million. Most experts in this field doubt that the population of the United States will reach that number before it begins to decline. To be on the safe side, however, it is believed that plans should be developed for 200 million people.

The Food and Agriculture Organization of the United Nations has set the *optimum* daily energy requirements of man at 3,000 calories. The distribution of these calories among the carbohydrates, fats, and proteins is important. The vitamin, amino acid, and mineral content of the food must also be kept in mind. But the average diet in the United States exceeds the calorific and all the other requirements set by the FAO by very liberal margins. If the whole world ate in accordance with our standards, not over one-third of its 2¼ billion people could be fed at present world-production levels. In comparison with the average diet of all the other people on earth, this more-than-optimum diet of ours is nothing less than extravagant.

Acreage of Farm Land Can Be Increased

About 300 million acres of our best cropland would produce the food our people are now consuming, at present crop yields and living standards, and leave a reasonable quantity for export. If we substituted the "moderate-cost" diet suggested by the National Research Council, these cropland needs could be reduced approximately 20%. This

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would necessitate a 14% reduction in the consumption of animal and poultry products and the use of more potatoes and vegetables. As of today, however, a little over 400 million acres of land are being cropped. Additional acreage can be put to work if conditions warrant.

Approximately 19 million acres of arid and semi-arid land are now under irrigation. The Bureau of Reclamation estimates that 23 million more acres could be irrigated with the water at hand. The National Resources Board raises this to 31½ million acres. Between 5 and 10 million of this is expected to be brought into production within 25 years.

Economies are being effected in the use of water, and this expands the acreage. More ditches are being lined with concrete or other impervious materials to reduce seepage losses. Shorter irrigation runs aid further in water conservation. Multiple-purpose projects, serving the interests of irrigation, power, and city development, keep the problem constantly in the foreground. One company reports that, by taking advantage of the desert sunshine, it can produce distilled water from the ocean at a cost of 5 cents per thousand gallons.

In 1939, some 26 million acres of land were included in organized drainage projects in the humid areas of the United States. There are nearly 100 million additional acres of wet, swamp, and overflow land, of which about 18 million can be drained at a reasonable cost. The remainder can be brought under production if the need develops.

Drainage costs run from $20 to $30 an acre. To drain the land area requiring it in the 38 states east of the 100th meridian would cost about $500 million. Crop increases from drainage of farmed land run from 40 to more than 100%. In times of national prosperity, or in the event of great need, it should not be difficult, by state and federal aid, to drain large areas of this wet land for productive agriculture.

There are many other ways by which additional land can be made available. For example, the Dutch reclaimed some 400,000 acres from the Zuider Zee at a cost of $500 million. There are similar possibilities for reclaiming large acreages of land from the ocean along the lengthy shores of the United States. In many parts of this country, virtually waste land is now being rapidly reconditioned for agricultural use by the aid of bulldozers. Irrigation is being applied to some half million acres of land in the humid regions. By the use of soluble fertilizers, this practice can be greatly expanded to cover many acres of waste sand in what would constitute, in effect, a soilless-culture system. If the time comes that we have to resort to such enterprises on a large scale, we have the know-how to do it.

Great improvements are being effected in the management of some 40 million acres of summer-fallow land in areas of 10 to 20 inches of rainfall. Farmers are now keeping the surface rough, growing their crops on the contour, employing strip-cropping procedures, and using stubble-mulches. Steep land is being permanently planted to grass.

More than 1 billion acres of land are being used for grazing. Three quarters of this area consists of rangeland in the arid and semi-arid West. The productivity of this land is closely related to the rainfall. If this is not over 5 inches, up to 200 acres are required for each animal. At 20 to 25 inches rainfall, 12 to 35 acres are needed. The aim is to control grazing at the point where the animals increase weight at a rate of not less than 1 pound a day.

Mesquite, prickly pear, and sage brush tend to develop with overgrazing. Some 33 million acres of Texas rangeland are badly infested with mesquite, and 20 million more are seeded with it. But weed-killing chemicals offer great promise in the control of these and other types of undesired growth. Range owners are now railing-off sagebrush, using off-center disc-pit plows, applying seed-containing hay, and dropping pelletized seed from airplanes. Some 80 million acres need reseeding,

and this is rapidly being effected by modern techniques.

Large numbers of springs are being opened up and many ponds are being built as a means of preventing livestock from walking-off their gains while searching for water. Some 150,000 spring developments, 250,000 water reservoirs, and 150,000 wells are planned, as well as 100,000 miles of fences and 20,000 miles of trails. These and other improvements in the management of rangeland are raising beef yields over vast areas at a rate that more than keeps pace with the enlarging needs of our growing population.

Acre Yields Are Being Raised to Higher Levels

New types of plants are being bred to meet specific needs, old ones are being adjusted to a wider range of environment, and selection is being employed against undue loss from drouth, disease, and insect damage. In one generation, hybrid corn spread across the continent with an estimated 20% increase in yield. The same principle is being applied to grain sorghum to step-up yields, cut the stalks down to combine size, and shove this highly important crop farther into the desert. Both physical and chemical methods are now being employed in speeding-up changes in genes and in chromosome number and structure in a great variety of crop plants.

Chemistry is playing an ever more important part in getting plants off to a quicker start, speeding them on their way, protecting them against parasites, and improving the quality of product that finally finds its way to market. Mineral fertilizers pioneered the way. Now, wide-scale use is being made of DDT (dichlorodiphenyl-trichlorethane) and its analogues and isomers to control some 200 insects; BHC (benzene hexachloride) for wire-worms; TEPP (tetraethyl pyrophosphate) for aphids, thrips, and mites; DNTP (o-o-diethyl-p-nitrophenyl thiophosphate), which is 5 to 10 times as toxic as DDT, for a wider range of insects; DMTC (dimethyldithiocarbamate) for fungus diseases; 2,4-D (2,4-dichlorophenoxyacetic acid) for weeds, and ANTU (alphanaphthyl thiourea) for rats. There is reason to believe that nematodes and similar parasites, including the giant snail, will be brought under control by such chemicals. Antibiotics, like penicillin and streptomycin, will undoubtedly find important places in the control of diseases of both crops and livestock.

Crop acreages and areas are being adjusted to changing economic conditions, altered demands, more effective machinery, and better land-use programs. The possibilities in this connection are so great that it is difficult to present an adequate picture of them.

Cotton provides a striking example. Since 1925, the area devoted to this crop has been reduced from 44 to around 23 million acres, or nearly 50%. Yet the number of bales of cotton harvested has fallen only about 5%.

Part of the improvement in acre yields was due to the use of better seed and more fertilizer. But a much larger part of it is accounted for by movement of the acreage into Texas and California, where large-scale modernized operations were put into effect. The

". . . Tremendous strides have been made in awakening national interest in soil conservation. . . . The health of our people has improved in proportion to the increased use of chemicals on the soil."

160 man-hours required to produce a bale of cotton by the one-man, one-mule, hand-picking system has been reduced to about 28 man-hours by use of four-row tractors, flame cultivators, and mechanical pickers.

The need for land to grow cotton has been greatly lessened as a result of the production of synthetic fibers from wood pulp. Continued lowering of costs is being effected in the manufacture of non-cellulose fibers from coal, resins, and glass, and synthetic protein fibers are possible competitors of wool.

By 1950, less than half the cloth fiber used in the United States will come from cotton. Trees grow very rapidly in the humid south. Loblolly pines produce cellulose at the rate of about 650 pounds an acre annually without plowing, cultivating, or fertilizing. Nearly two and one-half times as many industrial research workers are devoting their time to wood fibers, from which rayon is made, as to cotton. If rayon is improved as much as is expected, it is predicted that less than 1 million bales of cotton will be used at 25 cents a pound, and not over 7 million bales at 12 cents.

Considerably less land is being required for growing corn. The area harvested fell from 110 to 85 million acres during the last 16 years, yet total production increased 25%. The improvement in yield was due to the use of hybrids, more seed per acre, heavier applications of fertilizer, and better machinery. No doubt the weather had a great deal to do with the record 3,650 million-bushel yield of 1948. But the 25 million acres of land retired from corn production were those that were least suited to this crop. In other words, better land-use programs came into operation.

Similar adjustments are being made with wheat. The area planted to this crop during the last 30 years has fluctuated between about 60 and 70 million acres. But the production of grain has risen nearly 50%. For the last 3 years it has averaged better than 1¼ billion bushels annually.

Many innovations are in store in farm mechanization by which acre yields will be further increased, harvesting losses lowered, and the need for labor lessened. The goal of the agricultural engineer in preparing the land and planting it to crops is a bladed machine that operates on a not-too-rapid rotary-tiller basis, incorporates trash and liming materials, applies high-pressure steam to kill weed seeds, disease organisms, and insect pests, firms the seedbed, and plants and fertilizes the seed, all in one operation. Recent engineering achievements include high-velocity low gallonage sprayers, dielectric hay driers, suction devices for picking up fallen seed and leaves, and combines for harvesting sugar beets and sweet potatoes. It is expected that the tractor will be transformed from a puller to a pusher type. This will permit a more rapid hitch and release and a better view of what is being accomplished.

The farm motor now milks the cows, cools the milk, pumps the water, cleans the stables, refrigerates the food, and heats the house in winter and cools it in summer. Artificial light gets the hens up earlier in the morning, rouses the pigs for a midnight snack, and illuminates the fields so the tractor can be kept going 24 hours a day. Having an air-conditioned house, the night operator can then sleep during the day.

Few persons realize the tremendous potentialities for food production in the United States. As the selling price of farm produce went up 2½ times during World War II, the consumption of fertilizer climbed in almost direct proportion. Many more tractors and other mechanical devices were put into operation. From 1940 to 1945, the investment in farm machinery was increased $2 billion. This permitted further replacement of horses and mules, with resulting saving of the feed they would have consumed. Some 7 million fewer laborers were required to do the work. The output per laborer was increased 50%. The net effect of

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Boron for Alfalfa*

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DURING the past few years it has become increasingly evident that many soils in Wisconsin are lacking in available boron for good growth of alfalfa. In the summer of 1946 approximately 60 per cent of the second crop of alfalfa in southern Wisconsin showed symptoms of boron deficiency, causing yields in some cases to be reduced by one-half. In 1948, a survey of nearly 900 alfalfa fields in 39 counties showed that 56.7 per cent of the fields were deficient in available boron for the normal growth of alfalfa. In one experiment in Green Lake county, the yield of second crop alfalfa hay was increased from 1,000 pounds to over 3,000 pounds by the application of boron.

Because of exhaustive cropping, boron has been removed from many soils faster than it is being made available. Soil analyses show that many of the acid light-colored soils and alkaline soils in general in Wisconsin are too low in available boron for normal growth of alfalfa. Soils should contain about 1.5 pounds, or more, per acre plow-layer of available boron for normal growth of alfalfa. These surveys and tests show that fertilization with boron is needed in many cases in Wisconsin for the satisfactory growth of alfalfa.

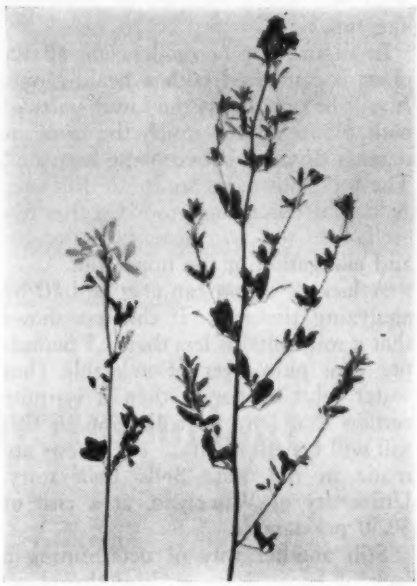

Fig. 1. (Left) Boron-deficient plant; (Right) Healthy alfalfa plant.

What Is Boron and How Supplied?

Boron is a chemical element that is needed by all crops for normal growth. Although the amount of boron required is small (a ton of alfalfa hay containing only about one-half ounce) plants cannot make growth without it. Boron is now commonly supplied in the form of a gray, granular powder called fertilizer borate, and a white powder called borax.

How Tell When Alfalfa Lacks Boron?

Symptoms of boron deficiency in alfalfa occur more often in the second crop than in the first. The most specific symptom is a stunting of the growing tip or uppermost part of the plant causing a telescoping together of the upper branches on each main stalk and an umbrella-like top growth. Flowering is checked or prevented. Since boron is required at the growing points, a

*Reprint of "Boron for Alfalfa," Extension Stencil Circular 296, July 1949, University of Wisconsin, Extension Service, College of Agriculture, Madison, Wisconsin.

lack prevents growth and elongation of these points and thus causes the umbrella-like appearance. A yellowing or reddening of the upper leaves and a sickly and stunted appearance of the plant also develop, but these conditions can also be caused by a deficiency of other elements, insect injury, and certain diseases, and hence, none of these is a positive symptom as is the one first described—the telescoped or umbrella-like top.

In Figure 1, a boron-deficient alfalfa plant is compared with a healthy one. It will be noted that the lower parts of both plants appear much the same as regards distance between the branches. The tops, however, are quite different. A lack of boron has produced the umbrella-like top by preventing growth and elongation of the upper tip.

A lack of boron can also be told by analyzing the soil. If the test shows that a soil contains less than 1.5 pounds per acre plow-layer of available (hot water soluble) boron, then it is quite certain that boron fertilization of this soil will benefit alfalfa. These tests are made in the State Soils Laboratory, University of Wisconsin, at a cost of $0.50 per sample.

Still another way of determining a lack of boron is to analyze the plant. If the dry tissue of alfalfa plants contains less than 10 pounds of boron in a million pounds of the tissue, a lack of boron is indicated. The labor and cost of making this test is the same as for the soil test.

General Appearance of Boron-deficient Alfalfa Fields

The more severe the boron deficiency, the greater will be the proportion of plants that are stunted, have umbrella-like tops, turn yellow or reddish, and fail to bloom. When the deficiency is mild, these symptoms show up in single plants or in spots; when severe, nearly all of the plants may exhibit some or all of these symptoms. Alfalfa affected in this way will not produce seed because the growing point cannot grow and flower. It is highly important to clearly distinguish leaf hopper injury and disease from boron deficiency symptoms.

Yellowing from boron deficiency occurs largely in the upper parts of the plants, and often only on scattered plants throughout the field. On the other hand, yellowing from leaf hopper injury occurs on the lower leaves as well as on the upper, and in the second crop generally starts at the edge of the field where the alfalfa was cut first. Boron deficiency may occur on any part of the field, and plants affected always exhibit umbrella-like tops.

Correcting Boron Deficiencies

Boron deficiencies in soils are corrected by adding a borate, such as borax, or fertilizer borate. The borate may be applied to established alfalfa fields any time from spring till late fall. It is of course best to apply it as soon as feasible after a deficiency is noted. If the borate is applied well in advance of the needs of the alfalfa, it will have time to dissolve in the rain water and be carried into the root feeding zone of the alfalfa so that it can be utilized when the need develops. For alfalfa, the borate is applied at the rate of 20 to 40 pounds per acre. It may be applied with a grass seeder, or it can be mixed and applied with other fertilizer.

Often fertilizer containing phosphate and potash is needed for alfalfa. This may be applied just prior to or at the time of seeding the alfalfa, or if need shows up later, on the established alfalfa as a topdressing. If boron also is needed, it is most conveniently applied as a fertilizer mixture containing borax. A good mixture for this purpose is an 0-9-27 grade containing 150 pounds of borate per ton. This should usually be applied at the rate of 300 to 600 pounds per acre.

Avoid Injury to Grain

Although boron is required for growth by all plants, it does not take much of it in the form of a borate to be very toxic to some plants, such as peas, beans, and the small grains. When a

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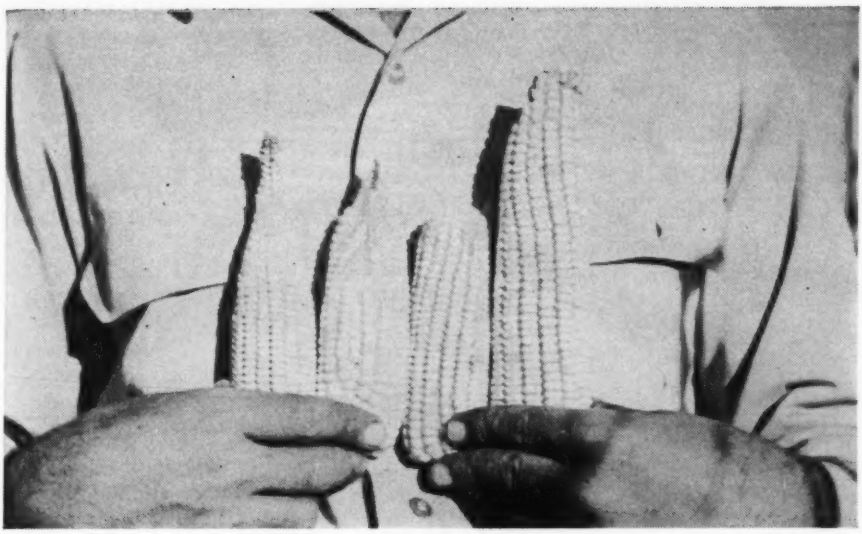

Fig. 1. These differences are due to plant-food deficiencies caused by variance in date of planting which affected plant-food and moisture intake.

All Factors Are Important

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PICTURED are four ears of Texas Hybrid 18 with definite nutrient deficiencies of, from left to right, potassium with its pinched tip of chaffy grain, phosphorus with its short incomplete rows, and nitrogen with its small blunt ear. On the right is a normal ear. Observation without explanation would lead one to believe that these ears show the results of some kind of experiment. They certainly show all these major element deficiencies.

That is not the case, however. The three ears of the left were grown in the same row and within 25 feet of the ear on the right, with no soil variation between them. All received the same amount of fertilizer, the only difference being in the planting date. The corn on the left was planted one month later than the corn on the right, which caused it to silk during the hot dry month of July with a limited moisture supply.

At silking time all deficiency symptoms shown in the abnormal ear development were clearly seen in the leaves. First a purplish color developed in some leaves showing definite phosphate deficiencies. Then a little later the leaves showed a nitrogen deficiency with a dead tip and a yellow streak running up the midrib. About the same time a potash deficiency showed up characterized by the leaves turning

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Fig. 1. Strip cropping on an Ohio farm, using a 4-year rotation of corn, oats, and two years of meadow to reduce soil and water losses and to provide a given acreage of all crops each year.

Use Crop Rotations to Improve Crop Yields and Income

By Harry H. Gardner

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THE use of crop rotations affects the management of soils, the farm enterprise, and the income of the farmer. When selected to fit the capability of the land, rotations (1) provide a systematic use of cropland, (2) increase the productivitity of the soil, (3) decrease soil and water losses, (4) diversity the production of crops and the farm income, and (5) help determine the type and size of the livestock enterprise of the farm. With these and other advantages in mind, it is difficult to understand why all farmers do not follow adapted crop rotations. Some of the reasons most commonly heard are (1) the difficulty to maintain the crop sequence, especially when meadow seedings fail, (2) the urge to grow corn and small grain crops when the market values are high or to feed livestock, and (3) the lack of understanding of crop rotations and how to arrange or rearrange fields to start a rotation.

A crop rotation is simply the growing of different crops in recurring succession on the same land. It is an orderly method of crop production—no continuous cropping to corn, to cotton, or to any other crop, and no haphazard change of crops from one year to another due to a lack of a definite plan.

Rotations usually consist of a combi-

nation of row or cultivated crops, small grain crops, and grass-legume meadow crops. They may be of any length, usually from 2 to 6 years. Under ordinary farming conditions it is practically impossible to maintain yields of row or grain crops in continuous culture; but when these crops are properly combined with grass-legume meadow crops to form a well-balanced crop rotation, the soil is improved and crop yields are increased. The highest yields are attained by the use of proper rotations and the replacement of the needed plant nutrients in the form of commercial fertilizer.

A rotation must include at least two crops and is usually understood to require the same number of years as there are crops in the rotation. However, in Missouri, a winter wheat and lespedeza rotation is used which includes two crops but requires only one year to complete the rotation. The land is prepared in the fall and seeded to winter wheat. Lespedeza is seeded early the following spring. The wheat is harvested for grain and the lespedeza provides pasture or hay the same year. Once the rotation is started, it is necessary only to disk the land in the fall and seed the wheat because the lespedeza volunteers. This rotation has been followed for 10 years or more on the same land with good results as far as the crop yields are concerned. However, it is questionable whether a desirable physical condition of the soil (tilth) can be maintained indefinitely under this system.

Two-year Rotation Popular

The 2-year rotation, corn followed by small grain with sweetclover as a catch crop, is very popular with farmers in the Corn Belt. It provides for the production of corn on half of the land and requires no haying equipment or roughage-consuming livestock. The sweetclover in this rotation provides some nitrogen; but without the use of a grass-legume sod, soil organic matter can hardly be maintained. The damage done to the sweetclover crop by the sweetclover weevil in the last few years reduces the dependability of the nitrogen supplied by this crop. The rotation ranks very low in its ability to resist erosion. For these reasons it cannot be classified as a soil-building rotation.

On heavy flat land, such as overflow river bottoms, a corn-soybean rotation is used. Floods often occur so late on this land that not even soybeans can be planted. This rotation is more soil-depleting than the corn-grain rotation just described because of the low nitrogen fixation by soybeans as compared to sweetclover, the lack of a deep-rooted legume to improve tilth, and the destruction of organic matter by two cultivated crops. It includes nothing to contribute to soil maintenance or improvement.

Corn-Meadow Rotation

Another 2-year rotation, corn-meadow, has considerable merit but is not commonly in use because of the hazard of establishing a meadow crop in corn at the last cultivation. This rotation does permit a large acreage of corn. In a strip-cropping system, it provides alternating strips of meadow and corn, and is, therefore, more erosion-resisting than the 2-year rotations already mentioned. Sweetclover and ryegrass are probably the best species to be used in the meadow. Sweetclover used for seed production can be a profitable cash crop, at the same time providing nitrogen, raw organic matter, and the soil-improving effects of a deep-rooted legume. Combined with a fibrous-rooted grass like ryegrass, it provides excellent resistance to erosion.

A 3-year rotation of corn-small grain-meadow (C-G-M)[1] is in more common use than any other rotation. It is simple, easy to establish, and provides a high percentage of corn and small grain crops. If such a rotation had been used on the prairie soils of the

[1] C means corn or any other cultivated crop; G, any small grain crop; and M, a grass-legume meadow.

Corn Belt continuously since they were first plowed, it is very probable that the productivity of the soils would be much higher than it is at present. However, it is doubtful that soils that are in poor tilth due to misuse can be improved significantly by the use of a 3-year rotation. The Morrow Plots in Illinois provide good evidence. In the 3-year rotation of corn-oats-clover, the nitrogen and organic matter have been reduced and the corn yields have hardly been maintained even with the use of hybrid corn. On the plots where manure, lime, and phosphate have been applied, organic matter has been maintained and crop yields have been increased. But, more manure is used in these experiments than is available under general farming conditions. Therefore, the results on the Morrow Plots are better than a farmer could expect. This rotation cannot be considered a soil-building rotation, although it meets more of the requirements than the C-G (sw.cl.) rotation because of the 1-year (stand-over legume) meadow crop.

Four-year Rotation

A 4-year rotation permits a greater selection and a more flexible arrangement of crops. It can be C-G-M-M, C-C-G-M, C-SB-G-M, C-G-G-M, G-G-M-M, and G-M-M-M. Of these, the C-G-M-M rotation is adapted to a wide range of conditions. It is not used uniformly throughout the Corn Belt, possibly because of the relatively small amount of corn, 25%, and the large percentage of meadow, 50%. More will be said of this 4-year rotation later.

The 5-year rotation is even more flexible than the 4-year rotation. It includes such combinations as C-G-M-M-M, C-C-G-M-M, C-SB-G-M-M, C-G-G-M-M, C-C-G-G-M, C-C-SB-G-M, G-G-M-M-M, G-M-M-M-M, and perhaps others. Only the first and the last two rotations mentioned, C-G-M-M-M, G-G-M-M-M, and G-M-M-M-M, can be arranged in satisfactory strip-cropping systems, that is, where a meadow strip separates corn and grain strips. The C-G-M-M-M rotation is popular in the dairy sections; the C-C-G-M-M and the C-SB-G-M-M rotations are somewhat popular in the Corn Belt. The C-G-G-M-M rotation is popular where winter wheat is grown. Unfortunately, a 5-year crop sequence resembling C-C-SB-G-M has been too widely used.

The 6-year rotation is still more flexible than the 5-year rotation. It can include rotations such as C-G-M-M-M-M, C-C-G-M-M-M, C-C-G-G-M-M, and several other combinations of crops. Any 6-year rotation that contains 3 or 4 years of meadow can be arranged in strip-cropping systems. Small grain and meadow rotations are used in grassland farming.

Longer Rotations

Longer and more intensive rotations can be made by combining two short rotations such as C-C-O-M-M-C-C-O (sw.cl.). This 8-year rotation has the advantages of a 4-year rotation, since it can be arranged in four fields so as to have two fields in corn, one in oats, and one in meadow each year. However, it is too intensive (50% corn), except perhaps for the most productive soils.

So far little has been said about the selection of the rotation. Too often the farmer uses a haphazard change in crops, influenced by the market price of corn, instead of a crop rotation. Market prices must be considered, but there are other factors that are more important, such as (1) increasing the productivity of the soil, (2) reducing erosion, (3) improving soil tilth, and (4) providing a profitable farm enterprise.

It would seem, from all of this, that the selection of the proper rotation for a farm is rather complicated. It is, to a certain extent, although after considering all of the soil-management factors, namely, replacing nitrogen and mineral plant nutrients, increasing organic matter, reducing erosion, and improving soil tilth, a 4-year rotation of C-G-M-M with appropriate soil conservation practices will usually meet the

Fig. 2. A 4-year rotation of corn, oats, and two years of meadow arranged in a strip-cropping system in Minnesota. It provides a systematic use of cropland and diversifies the production of crops and farm income.

soil requirements. Experimental work in Iowa on the size and stability of soil aggregates indicates that two consecutive years of grass-legume meadow are necessary to maintain soil tilth. The work on the Paulding soils in Ohio provides yield data that confirm the Iowa work. A 4-year rotation including two meadow crops can be used with any soil conservation measure, like contour tillage, strip cropping, and terracing. With the ordinary use of crops and crop residues, such a system can provide sufficient nitrogen and organic matter. And, contrary to popular opinion, it is a profitable rotation.

Taking the actual yield data from the rotations used in the Ohio Agricultural Experiment Station for three 4-year rotations and using the 10-year average (1934-43) farm prices from AGRICULTURAL STATISTICS, the average annual value per acre for a corn-wheat-alfalfa-alfalfa rotation is $45.46; for the corn-soybean-wheat-clover rotation, $32.53; and for the corn-oats-wheat-clover rotation, $32.08. These values are based on the sale of crops. Part of this reduction in value is due to decreased yields of grain following a 1-year meadow. Where the crops are fed to livestock on the farm, greater incomes could be realized. If it is desirable to measure the crops of the

TABLE I.—LEGUME MEADOWS INCREASE THE VALUE OF ROTATIONS.

Rotation [1]	Average annual value per acre [2]	Average annual total protein per acre [3]	Average annual TDN per acre [3]
C–W–A–A [4]	$45.46	511 lbs.	3,180 lbs.
C–SB–W–Cl	32.53	307 "	2,110 "
C–O–W–Cl	32.08	250 "	2,050 "

[1] Using actual yield data from Ohio Agricultural Experiment Station.
[2] Using 10-year average (1934-43) price of farm products from AGRICULTURAL STATISTICS.
[3] Computed by the Ohio Agricultural Experiment Station.
[4] W = wheat; A = alfalfa; SB = soybeans; O = oats; Cl = clover.

rotation by their feeding value, the average annual digestible protein is 511, 307, and 250 pounds per acre, respectively; and the average annual total digestible nutrients is 3,181, 2,110, and 2,050 pounds per acre according to the computations made by the Ohio Agricultural Experiment Station.

Using the yield data for three 5-year rotations from the Ohio Agricultural Experiment Station, namely, corn-wheat-3 years of alfalfa, corn-corn-wheat-2 years of alfalfa, and corn-corn-corn-wheat-alfalfa, and using the same prices for farm products from AGRICULTURAL STATISTICS, the average annual values of crops produced are $50, $45.17, and $38.21 per acre, respectively. Likewise, the amount of digestible protein and the total digestible nutrients in the crops grown are reduced as the amount of corn in the rotation is increased and the alfalfa decreased. This is strong evidence against the argument that a large acreage of corn must be grown in order to pay off the mortgage.

From this, then, it might be concluded that the 4-year rotation C-G-M-M is well balanced and applicable to a wide range of farm conditions. Where it is desirable to use a more intensive rotation, because of the high quality of the soil and the needs of the farmer, a year of corn may be added. This makes a 5-year rotation, C-C-G-M-M, and raises the acreage of corn from 25% in the 4-year rotation to 40% in the 5-year rotation. By adding the 2-year rotation, C-G (sw.cl.), to the C-G-M-M rotation, a 6-year rotation C-G-M-M-C-G (sw.cl.) is obtained. The acreage of corn is raised from 25% in the 4-year rotation to 33⅓% in the 6-year rotation, thus providing for the same acreage of each crop as a 3-year rotation. But, two consecutive years of meadow (plus a sweetclover catch crop) have greater value from a soil-management viewpoint than two 1-year meadow crops in the same period of time. This rotation could be expected to give higher yield.

A less intensive rotation can be formed from the basic 4-year rotation by substituting grain for corn, making a G-G-M-M rotation; meadow for corn, making a G-M-M-M rotation; or by adding small grain and a sweetclover catch crop, making a C-G-M-M-G (sw. cl.) rotation.

TABLE II.—NITROGEN CHANGES DUE TO CROP UTILIZATION.[1]

(Average Annual Pounds Per Acre)

Rotations[2]	Fed[3]	Sold[4]	Pastured[5]	Plowed[6]
C–W–A.....	8	−40	2.7	16.0
C–W–A–A....	35	−36	11.0	25.0
C–W–A–A–A.	42	−34	4.6	16.0
C–C–W–A–A.	24	−39	−.4	11.4
C–C–C–W–A.	−4	−40	−15.5	−7.6
C–SB–W–Cl..	8	−36	−12.4	−4.8
C–O–W–Cl...	−7	−46	−20.0	−15.0

[1] Using factor reports in "Planning the Farm Business," Univ. of Ill.
[2] Using rotations and actual yields from Ohio Agricultural Experiment Station.
[3] All crops fed and manure returned to the soil.
[4] All crops sold and nothing returned to the soil except crop residues.
[5] All crops sold except one year of meadow is pastured (the last year when there is more than one year of meadow).
[6] All crops sold except one year of meadow is plowed under as a soil-improving crop.

The data in column two above show that where the crops are all fed on the farm and the manures returned to the soil, it is only the very intensive rotations that show a loss of nitrogen, such as a loss of four pounds for the C-C-C-W-A rotation and seven pounds for the C-O-W-Cl rotation. But if all the crops are sold (column three) and nothing returned to the soil, all of these rotations show a heavy average annual loss of nitrogen. Where all the grain and hay is sold but the last year of the meadow is pastured (column four), one, two, and three years of alfalfa meadow produce a gain in nitrogen provided there is only one year of corn in the rotation. If the last year of meadow is plowed under as a soil-improving crop (column five), the gains in nitrogen are much greater.

(*Turn to page 39*)

PICTORIAL

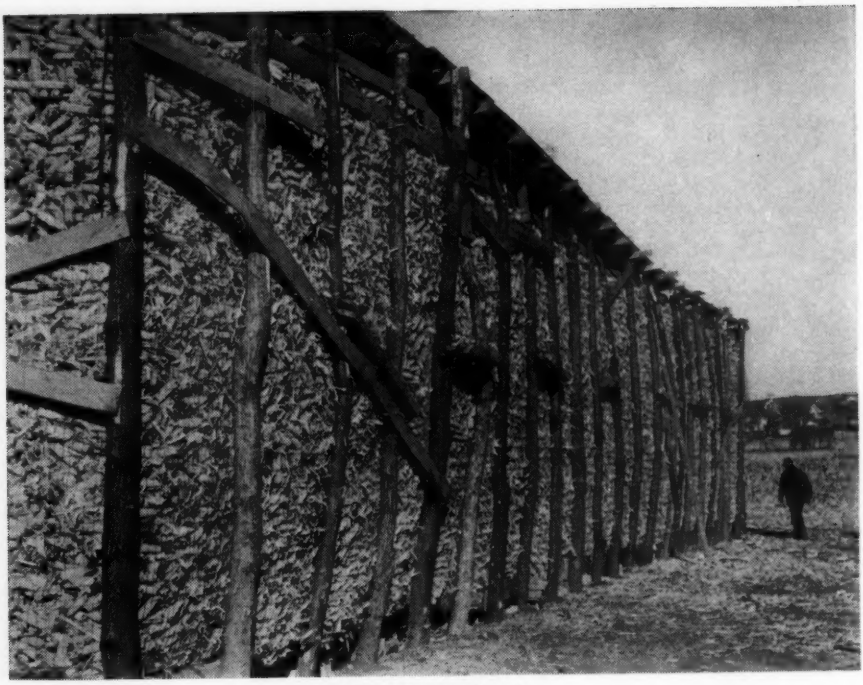
Chores! . . . Damn 'em! ! !

Above: Nectar from the trees.

Below: Feeding spring seeding.

Above: Flooded farm land.

Below: Gully-wash damage.



Above: Corn on the cob.

Below: Corn—no cob.

The Editors Talk

The South Reviews Its Agriculture

Coming together to hear discussions built around the general theme, "The South's Agriculture Is on the March—Let's Tell More About It," some 1,500 Southern Agricultural Workers held the 47th Annual Convention of their Association in Biloxi, Mississippi, February 9-11. Sunny skies lent an added optimism to the pride over what has been accomplished and the determination to solve the problems ahead. The convention, largest of its kind in the country, attracted research workers and extension people in the fields of agricultural economics and rural sociology, engineering, agronomy, animal production, dairy science, forestry, horticulture, marketing, phytopathology, plant physiology, poultry, and soil conservation. In addition, the home economists held several sessions and the agricultural editors reviewed their means of disseminating the wealth of information which is coming from the progress in the New South's agriculture.

There was no settling back on "laurels won." Rather, did the greatest attention center on the problems ahead. For instance, Dr. R. Q. Parks, Soil Scientist of the U. S. Department of Agriculture, told a large group of crops and soils men that in a look ahead at research needed to solve soil-management problems in the humid South, the maintenance of fertility and better use of water are the chief concerns. He listed five broad problems which call for study, as follows:

1. The favorable levels of available soil phosphorus for different crops and soils. Southern farmers apply an average of 3½ times as much phosphorus in fertilizers as is removed in crops. If favorable levels were known, it might be more economical to apply the phosphorus all at one time rather than in small amounts over a period of 25 to 125 years.

2. The extent to which deep-rooted legumes such as sericea and kudzu can be used to improve the soils.

3. The rates at which native potash is released and how this release can be modified by management practices.

4. Much more information on the availability of minor elements in soils and the effect of modern management practices on their release.

5. The possibility of using a wide range of liming rates together with greatly increased applications of the minor elements and potash, magnesium, and phosphorus to increase and maintain soil fertility.

Turning to water conservation in soil management, Dr. Parks said in some areas Southern farmers can do a great deal to supplement rainfall but those on far larger acreage must give attention to getting more efficient use of the rain that falls on the land. The use of supplemental irrigation has increased in the South as the result more of farmer interest than of agronomic recommendations. If irrigation is to be used efficiently in the humid South, research is needed to find detailed answers to the following questions:

1. What are the potential sources of water supply of surface water and the quality and potential volume of supply of underground water within economic reach for pumping?

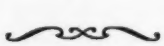
2. What are the agricultural potentialities of supplemental irrigation in areas near good water supplies?

3. What state laws have been passed relating to the appropriation of surface and underground water resources for supplemental irrigation? Should model legislation be developed to define and protect such water rights?

A major question in developing more efficient use of the rainwater that falls on the land, Dr. Parks feels, is how much a combination of good management practices—use of improved varieties and high fertilization—can decrease erosion. Another question that needs to be answered is what depth can available soil water be stored on different soil types and to what depth can it be removed by plant roots. A crop that roots to a depth of three feet has available a soil-moisture reservoir three times as large as a crop that roots to only twelve inches. Most Southern soils have potential root-zone depths that are not being utilized.

Numerous papers were devoted to pasture and their management, a subject of great importance and significance in view of the necessity for finding use for many acres of land being taken out of cotton and other row crops. Joint meetings and symposia were held on methods for determining the nutrient requirements of crops, fertilizer needs of soils, fertilizer formulation and use, and farm mechanization.

The South is to be congratulated on having this Association of Agricultural Workers. It is in such meetings as their conventions that problems on an area-wide basis can best be discussed. It is in such discussions that the true interdependence of each phase of agricultural research with the others is best realized. From such realization and a working together comes the real March of Progress.



Food for Thought About Food

In this issue of this magazine we are pleased to begin the reprinting of Dr. Firman E. Bear's widely acclaimed presidential address before the American Society of Agronomy in Milwaukee, Wisconsin, last October. His subject, "Food for Thought About Food," was just that and with it, citing what already has been accomplished by agricultural science and what will be accomplished, he dispelled any fear that our future generations with their increasing populations will go hungry.

Dr. Bear prefaced his address with the Malthusian principle, the growth of population, and the agricultural development in the New World which refuted the concepts of Malthus. From there he speculated on the increased population which will have to be fed and clothed in coming centuries and the potentialities in food and fiber production with which to meet these needs. He outlined the acreages which can still be put to work with proper technology, the possibilities of increasing acre yields, the solving of soil problems, and the control of diseases and pests. In closing he dwelt upon the synthetic production of food, when and if the need ever arises.

We believe that all of our readers who did not have the privilege of hearing the talk or seeing it in print elsewhere will thoroughly appreciate our printing of it and find in it much "food for thought."

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay[1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1925.....	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	31.0	38.7	153.0	219.0	136.0	205.0	19.00	67.80	....
1949									
February....	29.14	29.5	172.0	244.0	112.0	194.0	20.50	53.40	....
March.....	28.74	31.9	174.0	254.0	118.0	198.0	20.00	51.40	....
April.....	29.91	24.7	181.0	275.0	122.0	200.0	19.00	50.30	....
May.....	29.97	32.5	181.0	273.0	122.0	200.0	17.70	50.40	....
June.....	30.13	31.5	175.0	264.0	121.0	186.0	16.40	46.70	....
July.....	30.08	56.5	155.0	283.0	125.0	182.0	15.65	37.50	....
August.....	29.32	44.6	154.0	267.0	118.0	179.0	16.05	44.40	....
September...	29.70	48.7	138.0	230.0	116.0	187.0	16.25	43.50	....
October.....	28.70	47.4	130.0	196.0	109.0	189.0	16.75	41.80	....
November...	27.76	43.4	134.0	189.0	102.0	190.0	16.75	42.30	....
December....	26.50	45.4	131.0	202.0	113.0	193.0	17.15	43.30	....
1950									
January.....	26.47	39.7	136.0	215.0	115.0	192.0	17.15	43.60	....

Index Numbers (Aug. 1909–July 1914 = 100)

1925.....	158	168	245	188	109	163	108	140	143
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	224
1946.....	263	382	178	248	212	209	141	319	204
1947.....	257	380	232	248	336	259	148	381	249
1948.....	250	387	220	249	212	232	160	301	238
1949									
February....	235	295	249	279	174	219	173	237	285
March.....	232	319	250	290	184	224	168	228	263
April.....	241	247	260	314	190	226	160	223	236
May.....	242	325	260	312	190	226	149	224	213
June.....	243	315	251	301	188	210	138	207	175
July.....	243	565	222	323	195	206	132	166	185
August.....	236	446	221	305	184	202	135	197	174
September...	240	487	198	263	181	212	137	193	205
October.....	231	474	187	224	170	214	141	185	170
November...	224	434	192	216	159	215	141	188	213
December....	214	454	188	230	176	218	144	192	196
1950									
January.....	213	397	195	245	179	217	144	193	261

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	10.11	10.59	10.84	9.85
1949						
February	3.19	2.27	9.44	12.36	10.78	10.70
March	3.19	2.27	9.27	12.36	9.64	9.71
April	3.19	2.27	9.22	12.36	9.71	9.87
May	3.19	2.27	9.43	12.36	9.71	9.11
June	3.19	2.28	9.65	13.34	10.02	9.71
July	3.19	2.32	11.07	14.97	11.53	10.78
August	3.19	2.32	11.88	14.49	12.75	12.14
September	3.19	2.32	9.83	14.53	11.53	11.53
October	3.08	2.32	9.94	14.58	11.29	11.65
November	3.00	2.32	10.39	14.21	10.39	10.78
December	3.00	2.32	12.94	13.88	9.87	9.94
1950						
January	3.00	2.32	10.27	13.79	10.26	10.08
Index Numbers (1910-14 = 100)						
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949						
February	119	80	270	350	320	304
March	119	80	265	350	286	276
April	119	80	263	350	288	280
May	119	80	269	350	288	259
June	119	80	276	378	297	276
July	119	81	316	424	342	306
August	119	81	339	410	378	345
September	119	81	281	412	342	328
October	115	81	284	413	335	331
November	112	81	297	403	308	306
December	112	81	311	393	293	282
1950						
January	112	81	293	391	304	286

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.498	.706	18.93	.195
1948	.764	4.27	6.60	.478	.681	14.14	.195
1949							
February	.770	4.61	6.60	.375	.720	14.50	.200
March	.770	3.85	7.06	.375	.720	14.50	.200
April	.770	3.85	7.06	.375	.720	14.50	.200
May	.770	3.85	7.06	.375	.720	14.50	.200
June	.770	3.66	7.06	.330	.634	12.76	.176
July	.770	3.60	5.87	.353	.679	13.63	.188
August	.770	3.60	5.47	.353	.679	13.63	.188
September	.770	3.65	5.47	.353	.679	13.63	.188
October	.770	3.75	5.47	.375	.720	14.50	.200
November	.770	3.76	5.47	.375	.720	14.50	.200
December	.770	3.76	5.47	.375	.720	14.50	.200
1950							
January	.762	3.76	5.47	.375	.720	14.50	.200
Index Numbers (1910-14 = 100)							
1925	110	68	126	82	90	98	74
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949							
February	144	128	135	68	76	60	83
March	144	107	145	68	76	60	83
April	144	107	145	68	76	60	83
May	144	107	145	68	76	60	83
June	144	101	145	62	67	53	80
July	144	100	120	65	71	56	82
August	144	100	112	65	71	56	82
September	144	101	112	65	71	56	82
October	144	104	112	68	76	60	83
November	144	104	112	68	76	60	83
December	144	104	112	68	76	60	83
1950							
January	142	104	112	68	76	60	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1925.....	156	153	151	112	100	131	109	80
1926.....	146	150	146	119	94	135	112	86
1927.....	141	148	139	116	89	150	100	94
1928.....	149	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	123	130	127	86	56	130	102	77
1942.....	158	149	144	93	57	161	112	77
1943.....	192	165	151	94	57	160	117	77
1944.....	196	174	152	96	57	174	120	76
1945.....	206	180	154	97	57	175	121	76
1946.....	234	197	177	107	62	240	125	75
1947.....	275	231	222	130	74	362	139	72
1948.....	285	250	241	134	89	314	143	70
1949								
February..	255	242	231	136	99	309	144	72
March....	258	245	231	134	99	290	144	72
April.....	256	244	229	134	99	291	144	72
May.....	253	244	227	134	99	293	144	72
June.....	249	242	223	134	99	304	144	65
July.....	246	240	225	140	100	349	144	68
August....	244	238	222	143	100	372	144	68
September.	247	238	225	138	100	334	144	68
October...	242	237	222	138	98	331	144	72
November.	237	236	221	136	96	321	144	72
December..	233	237	221	136	96	317	144	72
1950								
January...	235	238	220	135	96	316	142	72

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1]Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2]All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.

****The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Inspection of Commercial Fertilizers and Agricultural Lime Products," Fert. Control Serv., Agr. Exp. Sta., Univ. of Mass., Amherst, Mass., Control Series Bul. No. 142, July 1949.

"Fertilizer Experiments on Grasslands in the Northeastern Region," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 518, Sept. 1949, R. R. Robinson and R. J. Garber.

"Commercial Fertilizers in 1948–49," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Bul. 714, Sept. 1949, J. F. Fudge and T. L. Ogier.

"Vegetable Fertilizer Studies in the Walla Walla Area," Agr. Exp. Stations, State College of Wash., Pullman, Wash., Bul. No. 508, Aug. 1949, W. J. Clore and C. L. Vincent.

"Available Phosphorus and Potassium of Washington Soils According to the Neubauer Rye Seedling Test," Agr. Exp. Stations, State College of Wash., Pullman, Wash., Sta. Cir. No. 78, June 1949, H. E. Dregne, Errett Deck, Jr., and S. C. Vandecaveye.

"What Fertilizer Should I Use?" Ext. Serv., Univ. of Wis., Madison, Wis., Special Cir. 13, Oct. 1949, Emil Truog, C. J. Chapman, and K. C. Berger.

Soils

"The Chemical Composition of Representative Arizona Waters," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 225, Nov. 1949.

"Growth and Nutrition of Plants as Affected by Degree of Base Saturation of Different Types of Clay Minerals," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Tech. Bul. 214, June 1949, T. S. Chu and L. M. Turk.

"Irrigation Farmers Reach Out Into the Dry Land," Agr. Exp. Sta., Montana State College, Bozeman, Mont., Bul. 464, Sept. 1949, R. E. Ward and M. M. Kelso.

"How to Build a Farm Pond," U.S.D.A., Washington, D. C., Leaflet 259, Sept. 1949, W. S. Atkinson.

Crops

"Twenty-ninth Biennial Report—from July 1, 1944, to June 30, 1946," State Dept. of Agr., Tallahassee, Fla.

"Uniform Small Grain Variety Tests in Georgia, 1948-49," Ga. Exp. Sta., Univ. System of Ga., Experiment, Ga., Cir. 162, Oct. 1949, U. R. Gore, M. B. Parker, J. P. Craigmiles, S. B. Parkman, O. L. Brooks, and D. D. Morey.

"Crop Rotations for Preventing Root-knot Damage to Tobacco," Ga. Coastal Plain Exp. Sta., Tifton, Ga., Mimeo. Paper No. 8, Rev. Oct. 1949.

"Pastures for Illinois," Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 647, July 1949, R. F. Fuelleman, W. L. Burlison, and W. G. Kammlade.

"Wabash Soybeans for Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 354, 1949, A. H. Probst and G. H. Cutler.

"Grass Silage—How to make it . . . How to feed it . . . Advantages in its use," Agr. Ext. Div., Univ. of Ky., Lexington, Ky., Cir. 361, Rev. May 1949, W. P. Garrigus.

"Potato Growing in the Home Garden," Agr. Ext. Div., Univ. of Ky., Lexington, Ky., H-8, 1949, John S. Gardner.

"Dairying in Southern Aroostook," Agr. Ext. Serv., Univ. of Maine, Orono, Maine, Ext. Bul. 398, Nov. 1949.

"Year of Progress in Rural Maine," Agr. Ext. Serv., Univ. of Maine, Orono, Maine, Ext. Bul. 400, Nov. 1949, Annual Report, Arthur L. Deering.

"Agronomic Characteristics and Disease Resistance of Winter Barleys Tested in Missouri, 1943 to 1948," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Research Bul. 442, July 1949, J. M. Poehlman.

"Christmas Tree Farming," Ext. Serv., Cornell Univ., Ithaca, N. Y., Bul. 704, Rev. Aug. 1949, J. A. Cope.

"Farm and Home Garden Manual," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. No. 122, Rev. June 1949, H. R. Niswonger.

"Sirup Sorghum Varieties in Oklahoma Sorghum Performance Tests, 1943-1948," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Bul. No. B-340, Nov. 1949, J. B. Sieglinger, Frank Davies, and J. E. Webster.

"Sweet Potato Manual for 4-H Club Members," Ext. Serv., N. C. State College, Raleigh, N. C., Club Series No. 49, Rev. April 1949, H. M. Covington.

"Performance Tests of Corn Varieties and Hybrids, 1949," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Misc. Pub. MP-16, Dec. 1949, J. S. Brooks and Hartwill Pass.

"Feeding for Milk Production," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Bul. 464, July 1949, I. R. Jones and R. W. Morse.

"The Effects of Excess Solutes, Temperature and Moisture upon Damping-off," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 509, April 1949, W. S. Beach.

"Seedleaf Tobacco Strains of Pennsylvania," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 513, May 1949, O. E. Street, C. O. Jensen, and Richard Nailor.

"Pasture and Supplementary Sources of Protein for Pigs," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. No. 516, July 1949, J. L. Gobble, R. C. Miller, P. T. Ziegler, and F. L. Bentley.

"Responses of Cotton to 2,4-D," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Bul. 713, Sept. 1949, D. R. Ergle and A. A. Dunlap.

"The Genetics of Certain Factors Responsible for Lint Quantity in American Upland Cotton," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Bul. 716, Oct. 1949, T. R. Richmond.

"Information for Virginia Fruit Growers, 1949," Ext. Serv., Va. Poly. Inst., Blacksburg, Va., Bul. 131, Rev. Feb. 1949.

"Sweetclover-grass Pasture in Eastern Washington," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. No. 509, Sept. 1949, A. G. Law, J. L. Schwendiman, and M. E. Ensminger.

"The Farm Windbreak," Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 267, F. B. Trenk.

"Woodland Improvement," Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 305, June 1940 (Rev. Feb. 1949).

"Growing Alfalfa," U.S.D.A., Washington, D. C., Farmers' Bul. No. 1722, Rev. Dec. 1949, H. M. Tysdal and H. L. Westover.

"Grain Production and Marketing," Prod. and Mktg. Admin., U.S.D.A., Washington, D. C., Misc. Publ. No. 692, Oct. 1949, G. A. Collier.

"Eleventh Progress Report, 1946," Agr. Exp. Stations, Univ. of Alaska, College, Alaska.

"Dominion Experimental Station, L'Assomption, Que., Progress Report, 1937–1946," Exp. Farms Serv., Canada Dept. of Agr., Ottawa, Can., 1949.

"Pear Growing in the Annapolis Valley," Exp. Farms Serv., Dept. of Agr., Ottawa, Can., Publ. 824, Farmers' Bul. 156, Aug. 1949, R. D. L. Bligh.

"Guide to Crop Production in Nova Scotia," Field Crops Services Branch, Dept. of Agr. and Mktg., Halifax, N. S., Can., Publ. 1010, Jan. 1950.

Economics

"1949 Sugar Beet Production Cost Analysis, Imperial County," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif.

"Farmer's 1949 Income Tax," Ext. Serv., Okla. A & M College, Stillwater, Okla., Cir. 421-A.

"Credit Sources, Practices, and Opinions of Pennsylvania Farmers," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 514, June 1949, L. F. Miller and F. A. Hughes.

"Keeping Up on the Farm Outlook," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. No. 141, Nov. 30, 1949, Karl Hobson.

"Keeping Up on the Farm Outlook," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. No. 142, Dec. 30, 1949, Karl Hobson.

"Report of the Chief of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, 1949," U.S.D.A., Washington, D. C., Oct. 12, 1949.

"Report of Cooperative Extension Work in Agriculture and Home Economics, 1949," U.S.D.A., Washington, D. C., Oct. 15, 1949.

"Report of the Manager of the Federal Crop Insurance Corporation, 1949," U.S.D.A., Washington, D. C., Oct. 14, 1949.

"Report of the President of the Commodity Credit Corporation, 1949," U.S.D.A., Washington, D. C., Oct. 19, 1949.

"Report of the Chief of the Bureau of Dairy Industry, Agricultural Research Administration 1949," U.S.D.A., Washington, D. C., Sept. 1, 1949.

"Report of Activities under the Research and Marketing Act, 1949," U.S.D.A., Washington, D. C., Oct. 20, 1949.

"Crop Production, 1949 Annual Summary; Acreage, Yield, and Production of Principal Crops by States with Comparisons," Crop Rptg. Board, Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Dec. 1949.

"Apples; Production by Varieties, 1949, with Comparisons," Crop Rptg. Board, Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Dec. 1949.

"The Balance Sheet and Current Financial Trends of Agriculture, 1949," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Agr. Info. Bul. No. 1, Oct. 1949, F. L. Garlock, A. S. Tostlebe, R. J. Burroughs, H. C. Larsen, H. T. Lingard, and L. A. Jones.

"The Farm Real Estate Situation, 1947–48 and 1948–49," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Cir. No. 823, Sept. 1949, W. H. Scofield and R. D. Davidson.

"Planning That Pays," Farmers Home Admin., U.S.D.A., Washington, D. C., PA-74, July 1949.

"The 1950 Agricultural Conservation Program Handbook for: ACP-1950-Ariz.; ACP-1950-Calif.; ACP-1950-Mass.; ACP-1950-Mich.; ACP-1950-Miss.; ACP-1950-Mo.; ACP-1950-N. Mex.; ACP-1950-N. Y.; ACP-1950-Oreg.; ACP-1950-Utah; ACP-1950-Wash.; ACP-1950-Wyo.; ACP-1950-Hawaii; ACP-1950-Puerto Rico; U.S.D.A., Washington, D. C.

Science Explores Root Zone

BACTERIA and other microorganisms had been helping plant roots etch the ancient buried marbles of Greece and Rome for centuries before men learned anything about the biological forces within the soil and their effects on the nutrition of plants. Now experts on the microflora of the root zone have an active part in present widespread efforts toward a better understanding of the whole so-called soil complex. Dr. Francis E. Clark, microbiologist of the U. S. Department of Agriculture's Bureau of Plant Industry, Soils, and Agricultural Engineering, sees a "rebirth of interest in the biology of the soil" and thinks it is likely due in large measure to the parts these organisms play in the production of crops.

Writing in the American Journal of Agronomy, Clark throws light into this dark economy by explaining some of the collective accomplishments of the microorganisms. He describes them as: Providing plants with nutrients in more available form (they are processors); conserving and protecting nutrients for the later use of plants (storehouse watchmen); in some cases competing with plants for nutrients (like sparrows in the chicken yard); sometimes forming substances that improve tilth (same as in a compost pile); sometimes guarding plants against parasites (sheepdog work); and (as may surprise many) promoting the ability of plant roots to absorb nutrients.

According to Clark, products of microbial action have a dissolving effect on minerals in the soil—both those minerals found in organic combinations (vegetable and animal matter) and those inorganic ones (such as the mineral fertilizers). Then he shows how these dissolving substances from the microorganisms work. He says many microbiologists now believe that while these organisms are making the nutrients more suitable for absorption by the roots, they also are making the walls of the roots more permeable. As the substances the organisms produce etched the ancient marbles and tend to dissolve minerals in the soil today, so they erode the surfaces of the rootlets on which they swarm. There is evidence, he says that they even encase the rootlets so that the plants are not actually in contact with the soil particles at all but get everything through what we might well call micromiddlemen.

Use Crop Rotations to Improve . . .

(*From page 26*)

If the rotation contains three years of corn, small grain, and one year of meadow, there is a heavy average annual loss of nitrogen regardless of how the crops are utilized.

Besides the cash and feeding values of the crops grown, rotations should be soil-building in order to fill the needs of the farmer. Too often no consideration is given to this phase. If the crops in the rotation are profitable to grow or if they satisfy the feed requirements of the livestock enterprise, the farmer may forget that the needs of the soil are also a reason for using rotations. The way he uses the crops he grows has a great deal to do with the selection of the rotation that will maintain the soil. For example, a crop rotation that is soil-building when all of the crops are fed to livestock on the farm may be soil-deteriorating when the crops are sold.

There is always a loss of phosphate and potash from the soil no matter how the crops in a rotation are used. These must be replaced by using commercial fertilizer in order to keep the soil fertile. The supply of nitrogen and organic matter can be changed materially by the use that is made of the crops.

It has taken a lot of experimental

work on the various phases of soil management and a lot of experience in farm planning over a wide range of soil conditions to take the guesswork out of crop rotations and put them on a technical and practical basis. The old method of adjusting the crops to be grown to the feed requirements of the livestock enterprise has changed to one of adjusting the livestock enterprise to the amount and kinds of feeds the soil is capable of producing. The old measure of market supply and demand does not determine the selection of the crops in the rotation. Instead, the needs of the soil to keep it productive and in good physical condition indefinitely are the determining factors. Help in planning and establishing proper rotations, and information on proper land use, soil productivity, and erosion are available.

Fertilizer Placement for Vegetable Crops

(*From page 10*)

ing when irrigating is important. When irrigation water is applied at the surface it should not be so rapid as to cause fertilizer loss by surface runoff and it should continue until the moisture meets with the moisture down below.

Peikert and Cook in an article in Michigan Agricultural Experiment Station Quarterly Bulletin, May 1948, say, "Carolus has reported that potatoes, at the Virginia Truck Experiment Station, required only 7 lbs. of nitrogen an acre during the first 7 weeks of their growth period, but during the next 5 weeks the crop used 53 lbs. an acre. The logical time then to apply nitrogen for such a crop is during that period of rapid growth when the need for nitrogen is great."

The article states that only soluble salts such as ammonium sulfate, ammonium nitrate, and sodium nitrate can be effectively applied through irrigation water, and 40 to 80 lbs. of nitrogen per acre should be sufficient to take care of the rapid growth period of most vegetable crops which takes place several weeks after planting.

It is further stated that potash salts are largely soluble in water and yet do not leach readily from the soil nor form unavailable compounds in the soil. Therefore, all the potash may be applied at the time of planting or before. However, if tests show that the crop needs more potash it can be added through the irrigation water.

In the case of phosphorus, it is stated that tests show this element to be most effective when applied in bands. When phosphorus is broadcast and mixed with the soil, a large part of it is changed over into relatively unavailable compounds. The same thing happens when put into irrigation water. However, most of the phosphorus used in mixed fertilizer does not dissolve readily in water, and soluble forms of phosphorus are too expensive to use. So it is not practical to try to put phosphorus on through the irrigation water.

On our farm when we apply fertilizer through the irrigation system we dissolve it in a barrel and pass it through the centrifugal pump on the suction side. Where turbine pumps are used, the solution must be forced into the discharge line at a pressure higher than that of the pump.

Some Other Methods of Applying Fertilizer

1. Fertilizer attachments have been made to fit the plow and apply bands of fertilizer and lime in the bottom of furrows, but this is expensive and slows up the job of plowing. It is much faster to broadcast on the surface and plow under.

2. Band fertilizing can be done at the time of setting plants, but here

again it is apt to slow up the planting and can probably wait, especially if starter solution is used in the planter water.

3. Ordinarily fertilizer cannot be mixed directly with vegetable seeds without danger of burning. However, superphosphate can be safely mixed with grain crops.

4. Whenever fertilizer is used directly under or over the row, there is danger of burning the plants because of the movement of soluble materials upward and downward. Ordinarily there is not much movement sideways.

5. Recently anhydrous ammonia and other solutions have been used in irrigation water in the West, or for direct application by machine to the soil, and good results are claimed.

6. Minor element deficiencies have been corrected by use in the fertilizer and by direct application to the foliage of plants in the form of a spray. Manganese, zinc, copper, and several other elements can be absorbed from sprays directly on the leaves. For several years now we have had from 5 to 15 lbs. of borax and 25 lbs. of manganese sulfate mixed with our fertilizer.

Good Judgment Needed in Fertilizer Placement

1. *The nature of crops grown.* A knowledge of the extent of the root system of crops and the feeding habits in regard to plant-food requirement is essential. Fertilizer should be placed within the reach of plant roots, but still not close enough to cause root injury. In the case of asparagus the bulk of the fertilizer should be applied after the crop is harvested.

2. *The kind and amount of fertilizer used.* Phosphorus fertilizers become fixed in the soil if mixed with it. They do not shift their position in the soil and should usually be placed deeply in bands where they will do the most good. Crop roots may be burned with heavy applications of soluble inorganic nitrogen or potash salts.

3. *Timing the application.* Most crops require only small amounts of plant food in the early stages of growth. If all the fertilizer is applied at the start, and none later, on a long season crop, it may suffer from lack of plant food because of leaching and fixation.

The following is taken from page 5 of a special bulletin on "Methods of Applying Fertilizer," published in November 1948 by the National Joint Committee on Fertilizer Application, under the heading "Principles Involved in Fertilizer Use:"

"Topdressing and side-dressing with nitrogen, and sometimes with potash, are useful in minimizing the concentration of salts when heavy total applications are made, in providing nutrients at a critical or opportune stage of crop development, and in replacing plant food when losses result from leaching or other causes. Nutrients applied as side-dressings are of most immediate benefit to the plant when placed in moist soil in the root zone; but in making the application, excessive mechanical destruction of the root system must be avoided."

4. *Physical nature of the soil.* On sandy soils we have faster leaching, and more frequent applications are necessary. Sandy soils also have less buffer action and retentive capacity than heavier soils.

5. *Drainage.* Good drainage is necessary to provide aeration for the development of soil organisms which break down and release plant food.

6. *The pH level.* Phosphates are made more available in soils near neutral. A slightly acid soil favors the maximum release of plant food.

7. *The organic matter content.* Organic matter acts as a sponge to hold water and plant food and reduces the danger from fertilizer burning. It also acts as a buffer to prevent injury from heavy doses of fertilizer.

8. *Spacing of rows.* Generally band fertilizing has been done on wide row crops and not so much on close row crops, probably partly because of the difficulty in getting machines to do the

job and also because there is less danger of burning by broadcasting large amounts.

9. *Cover crops and crop residues.* Both add considerably to the organic matter in the soil. Cover crops can be used as a means of predigesting fertilizers applied to them for gradual release to future growing crops.

10. *Animal manures.* These are still as valuable as ever when obtained at a reasonable price, but the quantity is limited. They are usually deficient in phosphorus.

11. *Equipment available.* There seems to be machinery available for banding fertilizer on wide rows, but for close rows there seems to be a need for machines to place fertilizer in bands and for side-dressing multiple rows.

12. In conclusion, no one fertilizer placement is best for all soils and all crops. To get the most value and best crops from fertilizer requires proper placement. This, however, usually means a combination of several methods of application and a consideration of a number of factors affecting crop needs, the release of plant food, and absorption into the roots of plants.

All Factors Are Important

(*From page 21*)

brown and dying along the outer edge.

In the adjacent plot of early planted Texas 18, green color persisted and normal two-ear development was observed against the late planted corn with only one ear to each stalk. This and ear size accounted for a 25-bushel-per-acre difference in yield.

A limited moisture supply at the critical silking time restricted maximum plant-food utilization and these deficiencies developed. This situation frequently becomes possible under average farm conditions in Texas when moisture becomes the limiting factor of production. Under conditions of low rainfall which prevail over a wide area, it is very important to have more than a minimum requirement of the various plant-food elements in the soil.

Quite a large acreage in Lamar county is of a claypan type soil that develops a moisture shortage due to the inability of the soil to absorb water into the impervious subsoil. Subsoiling is becoming a practice by some of the farmers to store up the late winter and early spring rains. Then organic matter incorporated into the soil increases the capacity of the soil to take up and retain this moisture for later use. The use of more fertilizer also decreases the amount of water necessary for dry matter production. All go together for maximum yields.

Our farmers are doing something about this. Our cover crops for organic matter in the county increased from 14,000 in 1948 to 20,000 acres last year. One fertilizer dealer reported an 800 per cent increase in fertilizer sales this last March over the previous March, and the tractor dealers note an increased interest in subsoil plows.

We have reported yields of 118 bushels per acre upland corn and 132 bushels Red River bottom corn. These yields are unusual when compared to our average Texas yield of 16 bushels per acre and have received quite a lot of attention. This year the local Junior Chamber of Commerce has a corn contest planned and expects to see quite a few acres grow 100 bushels. We feel that we have been a little behind on fertilizer and cultural practices in the past but look to do some fast catching up.

Fig. 2. Potassium deficiency symptoms in alfalfa: (Left) Normal or healthy leaves; (Second from left) First stage of potassium deficiency indicated by white spots near margin of leaves; (Third from left) Second stage of potassium deficiency. The white spots have extended so as to entirely cover the margin, causing them to become whitish, yellow, and finally brown and dry; (Right) Advanced stage of potassium deficiency. Leaves have lost all chlorophyll and finally dry up.

Boron for Alfalfa

(*From page 20*)

borate alone or in a mixture with other fertilizer materials is applied near the time of seeding alfalfa with a grain nurse crop, it should be broadcast and worked into the soil a week or two before seeding to avoid injury to the grain. Borates alone or in a mixture should never be applied directly in contact with the seed of grains, peas, beans, and seeds in general because even relatively low rates will seriously retard or entirely prevent germination. This danger of injury does not exist when borates are applied on established alfalfa in the amounts and manner previously indicated.

Need for Potassium Often Accompanies That for Boron

Many alfalfa fields that show a need for boron also lack an adequate supply of available potassium. Fortunately, a deficiency of potassium in alfalfa is marked by definite and unmistakable symptoms. These are illustrated in Figure 2.

The spots which indicate a deficiency of potassium are always whitish and appear first on the margins, usually on the older leaves. They should not be confused with yellow or brown spots which appear any place on the leaves and are caused by insects and diseases. In nearly every alfalfa field, occasional leaves that exhibit these potassium deficiency symptoms may be found. It is only when a considerable portion of the plants exhibit these symptoms that the condition is serious enough to warrant application of potash fertilizer.

Summary

Much of the alfalfa in Wisconsin suffers from a lack of available boron in the soil. Because of this, yields are often low, seed production is greatly

reduced, and winterkilling is more severe than need be.

When alfalfa suffers from a lack of boron, the plants exhibit definite deficiency symptoms in the form of stunting of the growing tip of the plants which results in the formation of an umbrella-like top growth of a yellow or reddish color. A lack of available boron may also be detected by soil and plant analysis.

The remedy for a lack of boron is application of a borate at the rate of 20 to 40 pounds per acre, either alone or in a fertilizer mixture. The application may be made as a topdressing on established alfalfa fields, or just prior to seeding.

Alfalfa frequently suffers from a lack of lime, phosphorus, and potassium, and when one or more of these are also lacking (soil tests will tell), suitable correction must be made in order to obtain satisfactory results.

Put the Bee on Southern Agriculture

(*From page 13*)

83.5 pounds of seed per acre. No similar red clover was available a sufficient distance from the colony for a check on fertilization by only wild bees, bumblebees, and insects; however, previous observations indicated only 2 to 10 per cent of red clover pods contained seed in the absence of honeybee colonies.

This is the first time that a study of the relationship of honeybees to pollination and seeding of legumes has been made on red clover grown in Florida. A similar experiment was conducted on ladino clover, but due to an almost total lack of blossom, no data are available. Indications are that a longer length of day is needed to force the blooming of ladino clover.

Fig. 4. Pasture of Louisiana white clover and carpet grass averaged over 600 pounds of beef per acre per year for four years.

Food for Thought About Food

(*From page 18*)

this stepped-up activity was a 30% increase in production. In 1947-48, we not only exported nearly 19½ million tons of food products, but we ate about 10% more at home than before the war.

The number of acres of cropland remained nearly constant during the war. Much additional land that, with some improvement, could have been used for growing crops was not farmed for lack of labor. The only thing needed to bring such land into production, and to further raise yield levels of that already being farmed, is a suitable incentive, in terms of a reasonable selling price for farm produce over a period of years, and an adequate supply of labor and machinery.

Serious Soil Problems Being Solved

There are, of course, some serious soil problems that must be solved. The Soil Conservation Service has effectively dramatized the tremendous soil losses from the cultivated lands of this country. Widespread fears have been aroused, notably among city folks, that the nation's land resources will soon have been destroyed.

Within limits, these fears are well founded. Our European ancestors were unacquainted with the corn, tobacco, potatoes, peanuts, and tomatoes that we inherited from the Indians, and few of them had ever had any experience with cotton. Nearly 140 million acres of our finest land were being turned with the plow and planted to these clean-cultivated row crops, year after year, before anyone realized what disastrous effects their production was having on the staying powers of the soil.

The introduction of the tractor and its rapid growth in number from a mere 2,000, in 1909, to 2½ million much faster and more effective models by the end of World War II resulted in rapid acceleration of loss of soil by erosion. Some 50 million acres of hay and pasture land for mules and horses was released to the plow. Thousands of miles of fences were torn out for convenience in operating the tractor. The net effect was an ever-longer sweep of wind and water over an ever-larger acreage of cultivated land.

Erosion ruins the contour of the land and necessitates farming in patches. It may remove soil down to bare rock that cannot be farmed. One of the nation's foremost geologists has set the rate at which soil is formed from rock at not over 1 foot in 10,000 years. This is less than 400 pounds per acre per year. Multiply this estimated rate of renewal by 10, and still it is far from being fast enough to replace soil losses in many cases.

But tremendous strides have been made in awakening national interest in soil conservation and in bringing erosion under control. Millions of acres of land are now being farmed on the contour. Contour strip-cropping is being practiced on an ever-enlarging scale. Moldboard plows have been widely replaced by tillage implements that leave soil-protecting crop-refuse on the surface. Many livestock farmers have reduced their acreage of cultivated crops and are growing hay and grass instead.

Land-use planning programs are being developed by the Soil Conservation Service as rapidly as funds permit. The purpose is to provide a detailed map for every farmer as a guide in deciding which part of his land can be safely cultivated, and with what precautions, and which part must be put down to grass and trees. Hopefully, every agricultural county will soon have a full-time conservation specialist whose energies will be entirely devoted to this purpose.

Another serious result of soil erosion is the sedimentation in the bottoms of water-storage reservoirs. Some 2,000 of the nation's smaller reservoirs have already been filled with soil. The average life of these reservoirs is less than 50 years. At the current rate of sedimentation, one-fifth of our 9,000 large reservoirs, on which we depend for power, drinking water, industrial use, and irrigation, will be filled with soil by the end of this century.

Reforestation One Answer

One of the best answers to this problem in the humid regions lies in reforestation of the surrounding watersheds. Fortunately, in meeting this need, we give support to the forest resources program. Over 40% of our land area, or about 820 million acres, was originally covered with forests. Some 200 million acres of the best of this have been cleared. Much of the remainder is being cared for on a very haphazard basis. As a result, our annual timber harvest is not replaced, large areas of land are subjected to unnecessary erosion, flood waters pile up to dangerous proportions, and water supplies are polluted.

It is highly unfortunate that we have fallen so far short of the possibilities of transforming waste land into productive forests. One encouraging feature is the extent to which counties, townships, communities, and municipalities are undertaking forest enterprises. Some 10 million acres of land are now in community forests. These are designed for the protection of local water supplies, for sport and recreation, and for the protection of wild life. Some of them are self-supporting. Moderate charges are made for hunting, fishing, and camping, and incomes of $2 to $3 an acre are obtained annually from the sale of timber.

Our virgin forests contained about 8,000 billion board feet, but current reserves are only one-fifth that amount. The goal set by the U. S. Forest Service is an annual growth of 20 million cubic feet. This calls for 100 million more acres of our present forest land in intensive production and a fourfold increase in well-managed extensive stands. It requires that fires be brought under better control. In addition there is need for more advisory service to small owners of woodland, for improved planting and cutting management, for cooperative control of diseases and insects, and for wide-spread recognition of the fact that forests are long-time enterprises to be passed on intact from one generation to the next.

It now seems probable that marginal farming areas can be developed into joint livestock-farming and forestry enterprises. They need to be brought together in large enough units to provide 500 to 1,000 acres of farming land, which would permit of economy in the use of labor and machinery. The additional rougher acreage could then be devoted to trees for Christmas greenery and for poles, pulpwood, and saw timber. Such an operation is already under way on a highly profitable basis in northern Pennsylvania.

Trees have special value in that they constitute important reserves of food and fiber that can be used in time of necessity. Wood is readily hydrolyzed to sugar that can be used either directly as food or feed or indirectly in the manufacture of edible proteins and fats.

There is great need for protecting farms and cities that lie in the larger river valleys of this country. It was not until 1917 that officials of the federal government were sufficiently impressed with this problem to enact laws by which flood control could be effected on a large scale. Since then plans have been prepared for virtually all the critical areas, and they are being put into effect as rapidly as funds permit. Those for the Missouri River basin provide a good example. They call for the construction of 100 new reservoirs with storage capacity of 63 million acre feet of water. This would provide irrigation for nearly 5 million acres of land. It would also permit of the construction

of 22 hydroelectric plants that would yield more power than is now being used in the area.

About 25% of our water supply comes from underground sources. In some areas such water is being removed faster than it is being replaced. Notable instances of this occur in the Texas Panhandle; in Marcopa County, Ariz.; in the San Joaquin Valley, Calif.; and in Louisville, Ky. Another example is found in Philadelphia, where salt water is now being drawn into the city system. All of these argue for cutting down runoff, for improving the rate of water intake of soils, and for increasing their capacity to store water.

Soil Organic Matter Center of Interest

Physical deterioration of some of our farmed land is a troublesome fact. Most of the virgin soil from forest, prairie, and plain was in a good physical state when first put to the plow. In some areas the land had to be drained and in others it was underlain with impervious layers. By and large, however, bad physical state in any of our best land is chargeable to bad farming practices. It is associated with excessive cultivation, loss of organic matter, working the soil while it is too wet, running over the land with heavy machinery, permitting rain to beat down on bare soil, and allowing actual loss of soil by erosion.

The natural renovating agents are plant roots, organic matter accumulations, earthworms, frost, and desiccation. As full advantage as the type of agriculture permits must be taken of these natural processes. This calls for keeping the land completely covered as much of the time as possible, growing deep-rooted legumes as a regular rotation procedure, making use of manure, cover crops, and hauled-in organic matter, and applying such chemical amendments as will guarantee good growth of crops with large root systems.

Chemical agents are being directly employed for improving the physical properties of soils. Liming materials have long been used for this purpose in humid areas and gypsum in irrigated arid areas. More recently great interest has been aroused in the use of gypsum, either alone or in association with liming materials, in humid areas. In 1948, some 1,300 tons of gypsum were applied at rates of about 2 tons per acre in clearing up wet spots on New Jersey farms, and 5,000 tons are expected to be so used in 1949.

But there are those who believe that the chemical method of dealing with soil unproductivity is fundamentally wrong and that the only safe procedure is by way of organic manures. A world-wide organic-farming cult has been formed to support this concept. The members of this group claim that the answer lies in the production of composts on a very large scale. They say that compost-treated soils produce plants that have much greater resistance to disease than those obtained by the use of chemicals and that they pass this disease-resistance on to animals and man. The seed of such plants are said to yield new generations of plants with continued high virility, whereas seed from fertilized plants "run out."

These organic-farming enthusiasts are seriously concerned about the very large waste that occurs by way of our sanitary sewers. They point to China, where farming has been going on for 40 centuries without the use of fertilizers. In view of the number of serious famines of the past in China and the conditions that obtain there at the present, one might well hesitate to follow the example of that country.

Our sewage systems are designed to be effective in terms of both economy and sanitation. They constitute one of the niceties of modern civilization. Investments in sewage-disposal plants in the United States are of the order of $10 billion. The wastes of half the population are carried through these systems. The effluent, containing the soluble nutrients, is poured into the rivers and oceans. Much of the sludge, collected separately, is barged out to

sea, incinerated, or used for fill. Probably less than 25% of the human waste is returned to the land. Our annual loss in this material is equivalent to possibly 4 million tons nitrate of soda, 2 million tons superphosphate, and ½ million tons muriate of potash.

In a few cities, activated sludge, the result of forced aerobic decomposition, is produced for fertilizer purposes. The best example of this is in Milwaukee, where some 50,000 tons of Milorganite are produced annually. The revenue from the sale of this product is about $1½ million, which covers about half the cost of the operation.

Elaborate schemes have been proposed for the utilization of the sewage from New York City on the million or more acres of sand around Atlantic City. A study of the possibility of using the effluent from Philadelphia on land within a 40-mile radius on the New Jersey side of the city indicated that the installation cost would be $200 an acre and upkeep $15 to $20 an acre annually thereafter.

But in any such scheme the problem of sanitation is serious. There is danger both for those who work the soil and those who eat its produce. Much of the sewage from industrial centers carries substances that are highly toxic to plants. Furthermore, the costs of reclaiming and using both sludge and effluent are so high as to be a serious deterrent, and would require heavy federal subsidies.

Chemical Soil Amendments Play Important Part

A great many very intelligent men have studied the problems that are involved in maintaining and increasing the productivity of land. Most of them have come to the conclusion that development of the lime and fertilizer industries constitutes the most important advance ever made in the direction of providing plenty of good food. So effective are these chemicals that they are now being used in the United States alone at the rate of over 46 million tons annually. This is enough to fill four solid lines of 40-ton freight cars extending from New York to San Francisco. Instead of being a gigantic fraud, as the organic-farming enthusiasts would have us believe, they stand between us and any possible deficiency of food for centuries to come.

Only a few points in support of the use of chemicals as soil amendments can be presented in this statement. Both art and science played important parts in their development. The Romans knew, 2,000 years ago, that lime and wood ashes were effective in increasing soil productivity. Bones became an important article of commerce over 100 years ago. The natural nitrate of Chile became a popular soil amendment early in the nineteenth century. These materials found highly important places as supplements to animal manures, bird guanos, and human wastes. but all of them put together failed to meet the ever-growing needs of our rapidly increasing populations.

Fortunately, chemists and geologists came to our rescue. Chemists analyzed plants and calculated their nitrogen and mineral needs. Geologists set about the task of locating stores of these elements for replacement purposes. Abundant supplies of limestone, phosphate rock, and potash salts were found in ancient seas that are now dry land. Work was begun immediately to prepare these materials for use on the soil. Methods were developed for capturing nitrogen from the air. These fertilizer products are as *natural* as any other products on earth.

The health of our people has improved in almost direct proportion to the increased use of chemicals on the soil. Ours is one of the most healthful countries on earth. Life expectancy at birth has increased from 40 years, a century ago, to 67 years at present. So far as can be determined by this or any other known test, there is nothing fundamentally wrong with the chemical method of supplementing the organic manures that are being used on the land.

(To be concluded)

Splintered Acres

(*From page 5*)

others own several tractors of different power ratings so as to handle the varied tasks on member farms. Some of them do heavy plowing for farmers with crawler type machines, and then the farmers do the easier field tasks with horses and light tractors.

In diversified peasant-farming areas practically 100 per cent of the few combines which have been in use for the past three years are run by cooperatives. Similarly, co-op spraying equipment is used. One of these local units north of Paris has even begun to dust crops with a helicopter.

THESE local operating cooperatives belong in turn to larger regional set-ups, and they finally fit into a national union. The unions provide repair and heavy duty maintenance services for the local farmers everywhere. The one near Moselle is operating such service and procuring spare parts as well as new machinery. It keeps accounts for the locals and tends to the insurance details. It even runs a foundry for replacement of used plow points.

Few financial worries fret the French machinery co-ops. Probably two-thirds of their capital comes from loans granted by the national farm credit union, called Caisses de Credit Agricole. The factor of depreciation of equipment bothers some of the co-ops because members do not exactly grasp its true meaning.

ONLY a few of the older farmers find it hard to adjust to the new ways brought to them in the machine age. They often voice the fear that machines will deprive them of active jobs. The high price of oil and gas hovers like a threat over some of them, as they recall the occupation period in wartime when they could only run their tractors one day each month and had to resort

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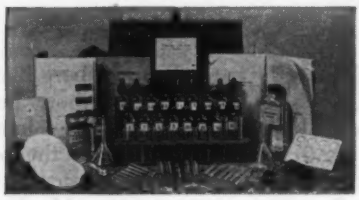

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to animal power again. They hope this won't happen now, but it halts the move to replace draft animals with machinery. Cows in many areas of France and Germany have their valuations ranked in terms of power, then meat, manure and finally milk. This must be changed to a greater emphasis on products from livestock.

One reason for success of these machinery units lies in the desire to maintain family-sized farms. This is because they place within the reach of the small farmer many advantages hitherto restricted to the large and wealthy operators.

TURNING to Wurttemberg-Baden in southern Germany, more notes on land use were obtained from Joseph B. Keim, extension leader with the food, agriculture, and fisheries division of the U. S. military government. Mr. Keim hails from Pennsylvania and is on leave to help set up practical extension work in that province, which is the second greatest food deficit zone of Germany.

The need for land consolidation to speed up mechanization is widely recognized and forms a major plank in a diversified extension plan now getting well started, with German youth aiding. The trouble is that the Nazis tackled this job and failed, and only through painstaking local demonstrations in the village land centers will any progress be possible.

THE usual approach has been through what the Germans called "flurboreinigung," or cleansing or adjustment of the fields. Its main positive results have been to straighten out the edges of the small strips and to eliminate a few cart roads. In spite of much expenditure of time and funds, the fields have been splintered apart faster than they could be cemented. Some of this arises from using the bureaucratic method, a sort of "perfectionistic" approach. German leaders, now sure that their agriculture faces bankruptcy under world competition and old costly systems, are happily joining the U. S. forces to reach farmers via conferences, meetings, educational material, and radio.

With 60 farmers I visited the village of Raunberg in the Heidelberg Kries. This area, centering in the stone cottage hamlet, has 229 operators of land totaling 1,150 acres. Friedrich Wilhelm Fischer, a leading farmer there, has 15 acres of land divided into 52 separate strips. He has six cattle, including two milk cows, eight hogs and eight pigs, and one horse. His cows averaged 8,150 pounds of milk a year, 3.7 per cent butterfat.

Fischer uses a seeder, a hay rake and mower, a motor sprayer, and a cider press and grape press. His regular daily labor force comprises himself and wife, a daughter, and a hired man. Three times weekly he employs one extra man and his wife. The map of his farm in relation to the entire commune was furnished by Mr. Keim. It shows the usual hopeless scattering of the tracts and the distance traveled to and fro and round about.

AS elsewhere in central Europe, the yields per acre are good. In fact, for the whole province itself the main crops give higher average yields than do those of Pennsylvania—but at a cost in wasted effort that seems pitiful to modern farmers. It all depends on the point of view.

A German law has been drafted to provide a short-cut land consolidation method, as well as a complicated standard plan something like the original used in France. Best present hope lies in the active extension demonstrations with machinery that help the farmers to take the first steps toward improvement. These are proceeding fairly well but are limited by lack of funds. Machinery dealers follow the demonstrations and often get orders for hand tools and a few larger machines. In any event, the volunteer, democratic way of influencing farmers through

teaching and example is the only logical process—a great relief to those so used to being regimented.

There's hardly any need to say how much the American farm tourists in Europe observed these evidences of the real need for modern motive power in farming, and how stoutly they insisted on immediate "reform." In a way, it's funny business. You see, our cash-crop farmers are in a surplus dilemma for the time being, and they want to see every legitimate export avenue used to sell excess wheat, cotton, and tobacco abroad. Meanwhile all steps taken with good results in getting the European farmers to produce faster and easier aim a direct blow at the European market for surplus farm crops grown in this country. However, there may be another and a brighter side to it. In a long-time outlook the general prosperity of Europe and the raising of their standards of living will be felt indirectly over here.

AT any rate, few of the men I visited with in Europe had the slightest reluctance to boost for bigger production and more power machinery over there. I guess it traces back to a sort of international fraternal feeling between men of the land. They do not hold back secrets from each other as far as knowledge of greater production and mechanical short cuts. Unlike industrial schemers and inventors, new facts and new methods are not kept under lock and key for a few monopolists. Yet the competition is often really fierce and keen between farmers, despite their open way of doing business.

So we find the tradition repeating itself as far as our attitude toward European agriculture. Our farmers are zealous missionaries, vocal supporters, and strong endorsers of all the good ways of work and the achievements of life. They want to pass them on to brethren across the ocean—whose misfortunes have been magnified by war's alarms and the prejudice of ancient customs.

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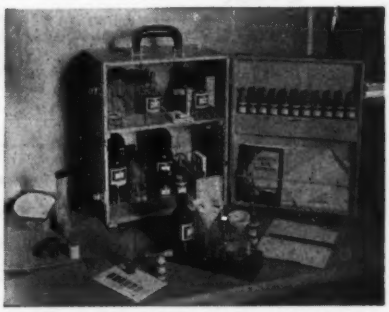

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IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

A tobacco farmer was asked why he refused to allow his daughter to enroll at college.

"Wal," he replied, "I started gittin' mad when they told her to go to the Registrar's Office to matriculate, but by cracky, I shore put my foot down when they said she had to use the same curriculum as the men!"

* * *

POKER FACES

The dining car waiter had taken the customer's three 1-dollar bills in payment for a $2.40 dinner. Presently, the waiter returned the change—a 50-cent piece, and a dime. The customer, a dour man, looked first at the change, then at the waiter's immobile face. He rose from the table, puffed on his cigar, picked up the half dollar, glanced again at the waiter—with a cool eye.

"It's all right, boss," and the waiter grinned from ear to ear. "I wins mo' times than I loses."

* * *

"Why did you strike the telegraph operator?" asked the patrol officer of the gob who was summoned for assault.

"Well, sir, I gives him a telegram to send to my wife, an' he starts reading it. So, of course, I ups and gives him one."

* * *

A bus repairman was filling out a report on a highway accident. When he came to a question, "Disposition of Passengers?" he candidly wrote: "Mad as Hell."

"Well, Dinah, what does the doctor say is the matter with you?"

"Why he tells me dat I'm sufferin' from hardenin' of de artillery, an' lan' sakes, I ain't even been neah no ahmy camp."

* * *

ASK FATHER!

Mother was absent from the dinner table; so Dorothy, aged seven, sat in her chair and pretended to take her place.

Father was watching the child's solemn assumption of matronly airs with ill-concealed glee, when her brother challenged her position with the remark: "So you're mother tonight? Well, if you're mother, tell me —how much is six times nine?"

Calmly and without hestitation, Dorothy retorted, "I'm busy—ask your father!"

* * *

When the teacher asked Johnny what George Washington was noted for, he surprised her by replying, "His memory." "Why do you think his memory was so great?" she inquired. Replied Johnny: "Because they erected a monument to it!"

* * *

Asked for a good definition of home, a traveling man replied, "A place where a man can scratch any place that he itches."

* * *

"Are you really ill?"

"Say, I'm so full of pills the doctors can't operate—I keep rolling off the table!"

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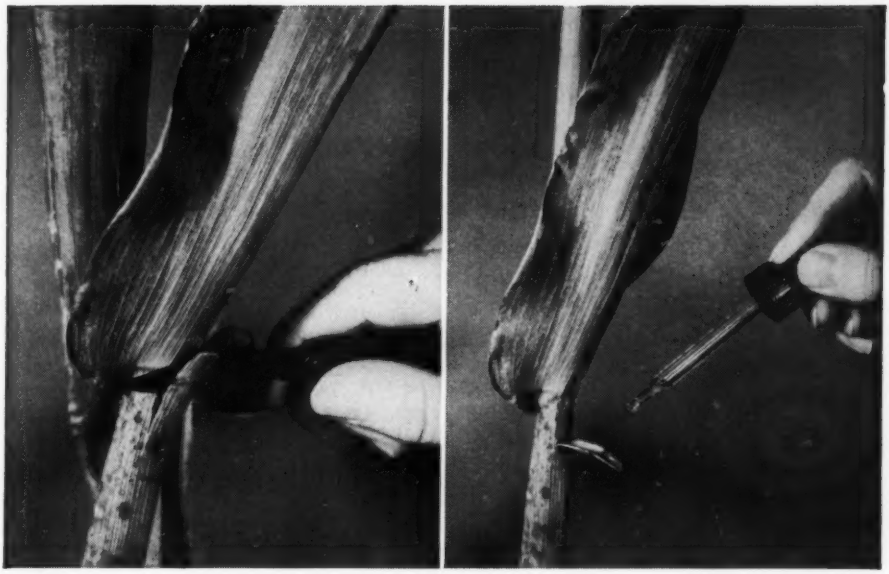

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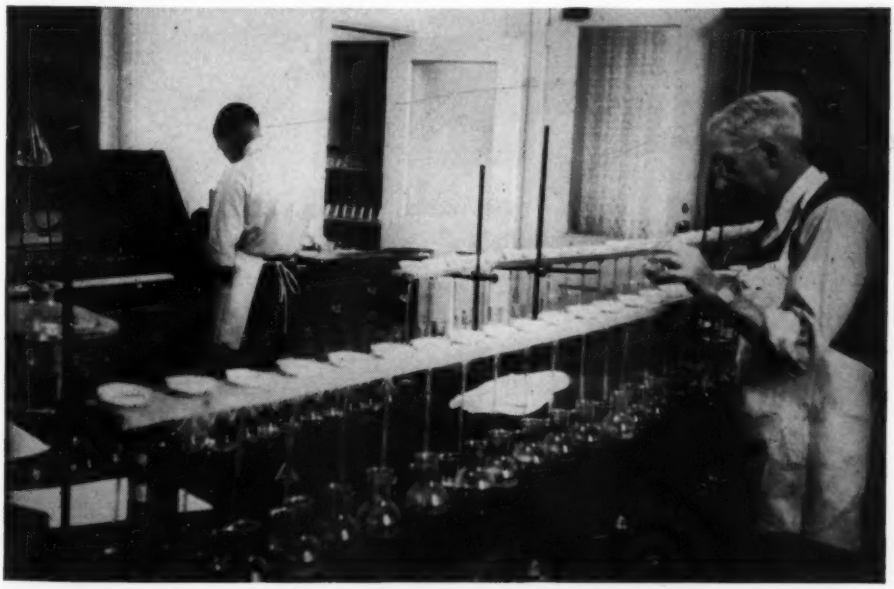

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